JOINT FORCES STAFF COLLEGE
JOINT ADVANCED WARFIGHTING SCHOOL

Petroleum Independence: A business case and strategy

by

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A paper submitted to the Faculty of the Joint Advanced Warfighting School in partial satisfaction of the requirements of a Master of Science Degree in Joint Campaign Planning and Strategy.

The contents of this paper reflect my own personal views and are not necessarily endorsed by the Joint Forces Staff College or the Department of Defense.

Signature: _____

14 April 2006

Thesis Adviser: Captain Dave Jerabek (USN)

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
15 MAY 2006		

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
Petroleum Independence: A business case and strategy	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Joint forces Staff College/ Joint Advanced Warfighting school,7800 Hampton Blvd,Norfolk ,VA,23511**	8. PERFORMING ORGANIZATION REPORT NUMBER **JFSC 25789**
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited.

13. SUPPLEMENTARY NOTES

14. ABSTRACT

The United States must divest itself from dependence on petroleum-based energy sources. Our entrenched dependence on petroleum has resulted in conflict, resentment, environmental failures, political disadvantage, and economic fracture. All of which have contributed to the erosion of our pole position in international affairs. This paper argues the business case that the US has arrived at the point in its history where it is now too expensive to pursue petroleum-based energy. The paper offers a real strategy to manage the shift towards petroleum independence by integrating government and business through active leadership and profit for all stakeholders. The plan consists of modular energy initiatives that are supportive, yet independent of each other. The recommended modules are designed to collectively relinquish our dependence on oil while achieving economic growth. Energy independence can be accomplished through conservation, wireless power transmission, alternate renewable energy sources, a conversion of our energy infrastructure (especially in the transportation industry), and sound governmental policy and investment. Further, petroleum independence will ultimately provide new options for the US and its allies regarding its national vital interests. The climate is now ripe for the implementation of a holistic energy strategy with the ultimate goal of petroleum independence.

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			
unclassified	**unclassified**	**unclassified**	**1**	**98**	

Abstract

The United States must divest itself from dependence on petroleum-based energy sources. Our entrenched dependence on petroleum has resulted in conflict, resentment, environmental failures, political disadvantage, and economic fracture. All of which have contributed to the erosion of our pole position in international affairs. This paper argues the business case that the US has arrived at the point in its history where it is now too expensive to pursue petroleum-based energy. The paper offers a real strategy to manage the shift towards petroleum independence by integrating government and business through active leadership and profit for all stakeholders. The plan consists of modular energy initiatives that are supportive, yet independent of each other. The recommended modules are designed to collectively relinquish our dependence on oil while achieving economic growth. Energy independence can be accomplished through conservation, wireless power transmission, alternate renewable energy sources, a conversion of our energy infrastructure (especially in the transportation industry), and sound governmental policy and investment. Further, petroleum independence will ultimately provide new options for the US and its allies regarding its national vital interests. The climate is now ripe for the implementation of a holistic energy strategy with the ultimate goal of petroleum independence.

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Statement / Introduction

Keeping America competitive requires affordable energy. And here we have a serious problem: America is addicted to oil, which is often imported from unstable parts of the world. The best way to break this addiction is through technology.[1]

- President George W. Bush

The US must divest itself from dependence on petroleum-based energy sources. There is much debate about when the earth's petroleum resources will be exhausted. Some say the world's petroleum reserves will be depleted in 10 to 30 or more years. However, there is zero debate that petroleum is a non-renewable resource and will eventually be eliminated if we continue along our extraction and consumption rates.[2 and 3] Using petroleum as a fuel source is analogous to the operators of the Hoover Dam burning the furniture in their office spaces to keep warm. Eventually, the furniture available will be expended, the delivery trucks that deliver replacement furniture may be interrupted, or the cost of buying new furniture will be untenable. Meanwhile, a virtually

1 State of the Union Address available at http://www.whitehouse.gov/stateoftheunion/2006/; Internet; accessed February 1, 2006.

2 Leading energy consultants believe peak production could arrive as early as 2014 available from http://www.btinternet.com/~nlpwessex/Documents/peakoil2014.htm; Internet; accessed October 12, 2005. Optimistic estimates believe peak petroleum production goes well into 2050 or greater available from http://www.opinionjournal.com/weekend/hottopic/?id=110007377; Internet; accessed October 11, 2005.

3 British Petroleum released its "Statistical Review of World Energy 2004" on June 15th. This year's report shows that at current rates of production, the world's proved reserves of oil are sufficient to last for 40 years, although nearly 77 percent of those reserves are located in OPEC countries. The proved reserves of natural gas are sufficient to last for 67 years at current rates of production, with the largest reserves in the countries of the former Soviet Union. Proved reserves of coal are sufficient to last 192 years at current production rates, with most reserves in North America, the Asia Pacific region, and Europe and Eurasia.
World energy use increased 2.9 percent in 2003, with the strongest growth (6.3 percent) in the Asia Pacific region. Among fossil fuels, coal grew fastest in 2003, with an increase of 6.9 percent, largely due to a reported increase of more than 15 percent in China. Chinese oil demand has also doubled over the past ten years, leading BP's Chief Executive, the Lord Browne of Madingley, to conclude in his

inexhaustible and economically feasible energy source fully capable of providing adequate energy for heat has been available all along. Because petroleum has a finite existence, our options are to do one or a combination of the following choices: 1) Reduce Demand, 2) Increase Supply or 3) Substitute/Supplement with an alternative energy.

Regarding a reduction in demand, to date we have not been able to reduce world demand for oil. In fact, our demand has increased steadily.[4] However, an alternative to reducing demand, or at least will have the same effect, is to use the available supplies more efficiently by implementing aggressive conservation policies. Regarding increasing petroleum supplies, the Bush Administration's current National Energy Plan (NEP) outlines a list of 8 alternative countries/sources for petroleum that are said to increase the supply of the world's petroleum.[5] However, the reality is that if there is an increase in supply from these sources, it will most likely be eclipsed by an increase in domestic (non-US) demand within foreign borders, thus nullifying any real net increase. Regarding substitute/supplemental energy sources, it is the only true long-term solution to the futile dependence on petroleum. The National Energy Plan (NEP) never discusses a reduction in petroleum dependency, but rather an increase.[6] However, the new Advanced Energy Initiative is a step in the right direction to curbing our oil dependence yet it still lacks sufficient thrust to accomplish this feat expeditiously.[7] Regardless, any changes in the

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foreword that China "will be a major influence on the world energy scene from now on." Available from http://www.zpenergy.com/modules.php?name=News&file=article&sid=797; Internet; accessed on March 13, 2006.

4 In 2002, the entire world's demand increased with the exception of eastern Europe and Russia available from http://www.eia.doe.gov/; Internet; accessed October 3, 2005.

5 National Energy Plan 2001 available from http://www.whitehouse.gov/energy/; Internet; accessed September 24, 2005.

6 The National Energy Plan 2001 makes no feasible recommendations to decrease oil demand, y et it does offer 8 countries/regions in which we could place pressure upon to increase their production of petroleum.

7 Advanced Energy Initiative 2005 available from http://www.whitehouse.gov/news/releases/2006/01/20060131-6.html; Internet; accessed September, 21, 2005.

petroleum supply, petroleum demand, and energy alternatives have economic, national security, political, and technological constraints.

As with most things in this world, there really are no new ideas under the sun, and this paper does not assert novelty in this area. There is however "news". That is to say, the world has many intricacies, ideas, and resources. However, through "news" we are unlocking never before seen secrets and communities/cultures are coming to revelations that other communities/cultures knew to be common practice. The conditions, organization, and timing of these legacy ideas now allow for a paradigm shift to petroleum independence.

Any successful divestiture from petroleum-based energy will be enabled by advances in technology but will be driven by the two main reasons of why change occurs: 1) Leadership and 2) Advantage Gain.[8]

Leadership explanation: History has proven that with strong leadership one can successfully move individuals, communities, and nations through change. An example of how leadership made a difference after the great depression is Franklin D. Roosevelt's presidential leadership throughout the New Deal. With just one hundred days in office, FDR pushed program after program through Congress to create jobs, provide relief, and simulate the economy after the great depression.[9] This type of active leadership is what changed a seemingly gloomy circumstance to the booming economy we now relish.

Advantage explanation: Most things simply do not change unless there is an advantage of doing so in the eyes of the stakeholders. The predominance of the advantage in most situations is financial profit. Most things occur in business,

8 Developed by the author, but easily related to change management

government, and in the private sector because they result in financial gain. Although, it is conceded there is a minute portion of the aforementioned advantage that is intellectual or for the greater good. For example, some universities accomplish research because it will contribute to the knowledge base of the community and some activist organizations contribute their efforts to make the world a better place. Any realization of a true change in thinking and operations will require the merging of both leadership and advantage, regardless of the topic or subject.

This paper discusses the historical march of our dependence of petroleum-based energy to what our future holds if we maintain this course. Further it will outline the implications if we were to divest from petroleum-based energy as they relate to economics, national security policy, global politics, new energy alternatives, and environmental implications. Lastly, it will provide a real National Energy Plan / Initiative that is economically profitable, environmentally friendly, and frankly a choice made on our own terms, rather than the current situation that is approaching a flat-line.

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9 Available from http://www.bergen.org/AAST/Projects/depression/legacy.html; Internet; accessed on March 13, 2006.

Brief History of Petroleum & a Description of our Dependence

Our modern industrialized civilizations were formed on and are maintained by energy. Civilizations originally depended upon wood for fuel to be later replaced by coal, and subsequently were replaced by petroleum. The beginning of our arduous march to petroleum dependence began in the late 1800's. Texas was credited as the first location to produce minor amounts of oil, starting with a well in 1866 drilled by Lyne T. Barret near the east Texas town of Nacogdoches.[10]

Petroleum was selected as the premier energy source because it is a much better than wood or coal due to its ability to conform to a container for transportability and mobility. Petroleum allowed for a new freedom of movement and opportunity that wood and coal never provided. The private sector observed some expansion in petroleum usage up until the early 1900s, but the World War I era was a milestone event for its initial expansion for use in automobiles and aircraft. It was later during World War II that it significantly raised the demand level to new heights. This was due to the highly mechanized manner in which the allied and axis powers conducted warfare. If the internal combustion engine and jet technology were the heart of these war machines, then oil was their life-blood.

In the early 1940s the US had sufficient domestic petroleum reserves, thus we had no need to import petroleum from foreign sources. Because of this, energy remained

solely a domestic issue. However, by the end of WWII we realized we would have to import foreign oil, which led to its migration as a foreign policy issue.[11] The US has long been dependent upon copper and cobalt, but this dependence has rarely shaped government policy, like petroleum has managed to.[12] In the name of national security, exercised through military force, we have frequently exercised our interests over the past 50+ years to guarantee our access to foreign petroleum.

Post World War II we deliberately recognized that our domestic oil production was insufficient to meet our needs, so we turned our eyes to the Middle East. However that decision gave birth to a significant security issue that we weren't aware of, or prepared for. Yerbin identifies this as the start of our inexhaustible quest for oil, money, and national power.[13] Further, a painful reminder of the critical role that oil plays in the US economy is the fact that nearly every economic recession since WWII has come on the heels of global petroleum shortage and an accompanying surge in prices.[14] Specific examples of this are the OPEC increases in 1973-74, Iranian Revolution of 1979, 1990 Iraqi invasion of Kuwait, and the Katrina hurricane disaster in 2005. [15]

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10 The modern oil industry was later born on a hill in southeastern Texas known throughout history as "Spindletop". Petroleum education: The History of oil available from http://www.priweb.org/ed/pgws/history/spindletop/spindletop.html; Internet; accessed on December 10, 2005.

11 World production of crude petroleum was 2,077 million barrels a day in 1939 with the United States contributing 61 percent of that amount. Available from http://digicoll.library.wisc.edu/cgi-bin/EcoNatRes/EcoNatRes-idx?type=article&byte=30811112&isize=text; Internet; accessed February 20, 2006.

12 Events Affecting the U.S. Non-fuel Minerals Industry 1900-2000 summary available from http://minerals.usgs.gov/minerals/pubs/commodity/timeline/timeline.pdf; Internet; accessed on February 20, 2006.

13 World production of crude petroleum was 2,077 million barrels a day in 1939 with the United States contributing 61 percent of that amount. Available from http://digicoll.library.wisc.edu/cgi-bin/EcoNatRes/EcoNatRes-idx?type=article&byte=30811112&isize=text; Internet; accessed February 20, 2006.

14 Klare, Michael T.; Blood and Oil: The dangers and consequences of America's growing petroleum dependency; Metropolitan Books; 2004.

15 World oil markets price chronology available at http://www.eia.doe.gov/cabs/chron.html; Internet; accessed February 20, 2006.

During the 1973-1974 Arab oil embargo, the US experienced its first significant oil supply interruption with the cutoff of about 2.6 million barrels of oil per day. This resulted to about 55% of the world export market.[16] During the six-month disruption, the world oil price tripled, from about $3.12 per barrel to $11.65 per barrel.[17] In 1979, the Iranian Revolution resulted in a shortfall of 3.5 million barrels of oil per day and again caused oil prices to triple.[18] Further supply disruptions occurred in 1990 in the Persian Gulf War, translating to a loss of 4.6 million barrels of oil production per day over a three-month period, or about 13% of the world market.[19] This led to more than doubling in the world oil price from $9 to $24 per barrel.[20] These instances of oil supply disruptions and subsequent oil price hikes were each followed by an economic recession in the United States.[21]

The Carter doctrine of Jan 23, 1980 designated the secure flow of Persian Gulf oil as a "vital interest" of the US.[22] Although the end of WWII made our nation aware of how important petroleum supplies were to the US national interests, it wasn't until the Carter Doctrine that we persistently and actively pursued the security of the world's

16 Global Oil Supply Disruptions Since 1951, EIA and Measures of Oil Dependence, Kendell, J., EIA, 1998; Sept. 16, 1997. available from http://www.eia.doe.gov/security/distable.html and http://www.eia.doe.gov/oiaf/archive/issues98/oimport.html; Internet; accessed October 11, 2005.

17 Average prices in 1973-1974 derived from the world oil markets price chronology available at http://www.eia.doe.gov/cabs/chron.html; Internet; accessed February 20, 2006.

18 Average prices derived from world oil markets price chronology available at http://www.eia.doe.gov/cabs/chron.html; Internet; accessed February 20, 2006.

19 Global Oil Supply Disruptions Since 1951, EIA and Measures of Oil Dependence, Kendell, J., EIA, 1998; Sept. 16, 1997. available from http://www.eia.doe.gov/security/distable.html and http://www.eia.doe.gov/oiaf/archive/issues98/oimport.html; Internet; accessed October 11, 2005.

20 Average prices derived from world oil markets price chronology available at http://www.eia.doe.gov/cabs/chron.html; Internet; accessed February 20, 2006.

21 Global Oil Supply Disruptions Since 1951, EIA and Measures of Oil Dependence, Kendell, J., EIA, 1998; Sept. 16, 1997. available from http://www.eia.doe.gov/security/distable.html and http://www.eia.doe.gov/oiaf/archive/issues98/oimport.html; Internet; accessed October 11, 2005.

petroleum as a vital interest. This vital interest was evidenced by the re-flagging of Kuwaiti ships with US ensigns and escorting them through the gulf during the Iran-Iraq war, the 1990 Iraq containment (and subsequent Operations Southern and Northern Watch), and more recently the 2003 regime change of Iraq.[23]

The Gulf Region is no more stable now, despite multiple battles, than it was after the Carter doctrine declaration in 1980.[24] Unfortunately we are conjoined with the insecure region because we are now in full stride (42% of our country's energy sources come from petroleum) with our addiction to petroleum energy.[25] Currently, the US imports about 60 percent of the oil that it uses annually, with the Middle East region accounting for a little more than 24 percent of total US oil imports.[26] The biggest single contributor to US oil imports is Canada, with nearly 16 percent of total imports in the first nine months of 2005.[27] Canada is followed by Saudi Arabia, which accounted for 12.6 percent of total imports.[28] The top five was rounded out by Venezuela (12.4 percent), Mexico (11 percent) and Nigeria (9.2 percent), with Iraq holding the sixth position at 4.3 percent.[29] Whereas, in 1995, only 49 percent of U.S. oil was imported, with 20 percent of imports coming from the Middle East, with Saudi Arabia as the No. 1

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22 Available from http://www.jimmycarterlibrary.org/documents/speeches/su80jec.phtml; Internet; accessed December 2, 2005.

23 Klare, Michael T.; Blood and Oil: The dangers and consequences of America's growing petroleum dependency; Metropolitan Books; page 49; 2004.

24 An interesting vignette, in 1945, Riyadh had rejected an American proposal to station a small military training group in Saudi Arabia citing it would provoke violent criticism from reactionaries and fanatics within the region. Klare, Michael T.; Blood and Oil: The dangers and consequences of America's growing petroleum dependency; Metropolitan Books; page 51; 2004.

25 Available from http://www.gravmag.com/oil.html; Internet; accessed December 1, 2005.

26 Available from http://www.gravmag.com/oil.html; Internet; accessed December 1, 2005.

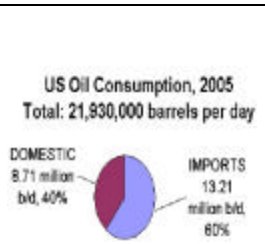
27 Available from http://www.gravmag.com/oil.html; Internet; accessed December 1, 2005.

28 Available from http://www.gravmag.com/oil.html; Internet; accessed December 1, 2005.

29 Available from http://www.gravmag.com/oil.html; Internet; accessed December 1, 2005.

source of US oil imports.[30] This is all evidence that it is possible to reduce our dependence on foreign oil especially from those regions of the world that lack stability.

Energy Source	Percentage of total
Petroleum	42%
Coal	24%
Natural Gas	20%
Nuclear	8%
Hydro power	2%
Solar, Wind, etc.	2%



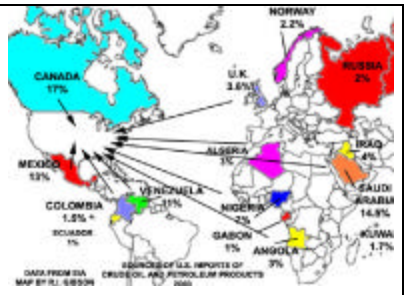


Figure 1, US Consumption and Source of Petroleum[31]

Further, 63 percent of the world's proven reserves are located in the Gulf region, as well as the greatest production capacity in the world.[32] Because of our dependence, we will not be free from regional security requirements in the Middle East in the near future, or our requirement for other petroleum reserves.

Now that we're familiar with the circumstance that petroleum built for our economy, it is important to discuss how deep our dependence goes.

30 Available from http://api-ec.api.org/newsplashpage/index.cfm; Internet; accessed January 11, 2006.

31 Available from http://www.gravmag.com/oil.html; Internet; accessed December 1, 2005.

32 The proven reserves are the supplies of untapped petroleum that are known to exist and can be extracted from their underground reservoirs using existing technology. Klare, Michael T.; Blood and Oil: The dangers and consequences of America's growing petroleum dependency; Metropolitan Books; page 75; 2004.

"With over 63 percent of the world's oil reserves located in the Gulf states of the region---from which the US imports 20% of its needs, Western Europe 43% and Japan 68%--the international community must have free and unfettered access to the region's resources." [33]

- General J. H. Binford Peay III--Commander US Central Command (1994-1997)

While discussing how deep this dependence goes, it's important to discuss where the source of the oil comes from, and how much oil reserve is remaining in the world:

Oil Reserves

1. Ghawar, Saudi Arabia	75-83 billion barrels
2. Burgan, Kuwait	66-72 billion barrels
2a. Cantarell, Mexico (often listed as a large complex of multiple smaller fields)	35 billion barrels
3. Bolivar Coastal, Venezuela	30-32 billion barrels
4. Safaniya-Khafji, Saudi Arabia/Neutral Zone	30 billion barrels
5. Rumaila, Iraq	20 billion barrels
6. Tengiz, Kazakstan	15-26 billion barrels
7. Ahwaz, Iran	17 billion barrels
8. Kirkuk, Iraq	16 billion barrels
9. Marun, Iran	16 billion barrels
10. Gachsaran, Iran	15 billion barrels
11. Aghajari, Iran	14 billion barrels
12. Samotlor, West Siberia, Russia	14-16 billion barrels
13.Prudhoe Bay, Alaska, USA	13 billion barrels
13a. Kashagan, Kazakhstan	13 billion barrels
14. Abqaiq, Saudi Arabia	12 billion barrels
15. Romashkino, Volga-Ural, Russia	12-14 billion barrels

Oil Production

Country	Production 1999	Rank & Production Early 2002	Rank & Production 2004
1. Saudi Arabia	7.3 million barrels/day	2. 7.7 mb/d	2. 8.8 mb/d
2. Former Soviet Union	7.1 million barrels/day	1. 8.0 mb/d	1. 9.1 mb/d
3. USA	5.9 million barrels/day	3. 5.7 mb/d	3. 5.4 mb/d
4. Iran	3.6 million barrels/day	4. 3.7 mb/d	4. 3.9 mb/d
5. China	3.2 million barrels/day	5. 3.3 mb/d	6. 3.3 mb/d
6. Norway	3.0 million barrels/day	6. 3.4 mb/d	7. 2.9 mb/d
7. Mexico	3.0 million barrels/day	7. 3.0 mb/d	5. 3.8 mb/d
8. Venezuela	2.8 million barrels/day	8. 2.8 mb/d	8. 2.7 mb/d
9. United Kingdom	2.7 million barrels/day	10. 2.6 mb/d	13. 1.8 mb/d
10. Iraq	2.5 million barrels/day	11. 2.4 mb/d	18. 1.3 mb/d
11. United Arab Emirates	2.1 million barrels/day	12. 2.2 mb/d	10. 2.2 mb/d
12. Nigeria	2.0 million barrels/day	13. 2.1 mb/d	9. 2.3 mb/d
13. Kuwait	1.9 million barrels/day	14. 1.7 mb/d	11. 2.1 mb/d
14. Canada	1.8 million barrels/day	9. 2.8 mb/d	15. 1.6 mb/d
15. Libya	1.3 million barrels/day	16. 1.6 mb/d	17. 1.3 mb/d
16. Indonesia	1.3 million barrels/day	17. 1.2 mb/d	19. 1.1 mb/d
17. Brazil	1.1 million barrels/day	15. 1.6 mb/d	16. 1.5 mb/d
18. Oman	0.9 million barrels/day	18. 1.0 mb/d	12. Other FSU - 1.9 mb/
19. Egypt	0.9 million barrels/day	21. 0.75 mb/d	14. Algeria - 1.7 mb/d
20. Colombia	0.8 million barrels/day	29. 0.62 mb/d	20. Angola - 0.9 mb/d

Table 1, World's Oil Reserves and Production[34]

33 General Binford made this statement to the house committee in 1997. Klare, Michael T.; Blood and Oil: The dangers and consequences of America's growing petroleum dependency; Metropolitan Books ; page 26. 2004.

34 Available from http://www.gravmag.com/oil.html; Internet; accessed December 1, 2005.

The United States is not alone in its deep dependence upon petroleum, but we surely posses the lion's share of its demand. Transportation, for example, accounts for approximately 2/3 of America's net oil consumption.[35] Further, light duty vehicles—automobiles, minivans, SUVs, and pickup trucks—together account for approximately 60% of all transportation-related petroleum consumption in our country.[36]

Oil is the wellspring of unimaginable wealth and hatred. It binds the wealthiest person in the world to the poorest. Oil is the single biggest actor for developed nations, and has been for the last century resulting in an increasingly bloody grab for the cheap, easily accessible oil reserves. Between now and 2025, there will be an additional 500 million cars in the world. Further the most significant emerging oil consumer, China, will double their demand as well as possesses the oil rights to Sudan, most of Venezuela, and most of the Middle East.[37] In order to ensure a continuous supply of petroleum to the US, we have had to engage in similar oil rights agreements in the past, and will continue to do so in the near future.

For example, money that we use to purchase petroleum from Saudi Arabia actually goes to the royal family, while the average Saudi citizen does not realize the revenues gained from oil.[38] Our security agreements are with the House of Saud, and not the Saudi population. In 1945, President Franklin Roosevelt invited King Abd al-Aziz to meet him aboard the U.S.S. Quincy. The two leaders cemented a secret oil-for-security

35 Estimates available from http://www.eia.doe.gov/pub/oil_gas/petroleum/analysis_publications/oil_market_basics/Demand_text.htm; Internet; accessed February 20, 2006.

36 Klare, Michael T.; Blood and Oil: The dangers and consequences of America's growing petroleum dependency; Metropolitan Books; page 193; 2004.

37 Estimates provided by Giannini, Robert M. and Le Pera , Maurice E.; Military Needs Efficient Fuel-Buying Process; National Defense Magazine; September 2004.

pact: The king guarantees to give the US secure access to Saudi oil and in exchange the US will provide military assistance and training to Saudi Arabia and build the Dhahran military base. This undoubtedly creates dissent or hatred towards the United States.[39] Our enemies are fully aware of how deep our oil dependence goes; yet we ourselves are just coming to this realization in the past few years.[40] A vicious circle of dependence has been formed—especially in our military operations designed to secure and protect the supply, yet consumes vast amounts of these supplies that it is protecting.

Typically, for operations in foreign countries, fuel represents more than half the tonnage needed to sustain military actions.[41] In Iraq, for example, US logisticians are working to create a network that supplies a force consuming 15 million gallons of fuel a day.[42] Fuel procurement is the responsibility of the Defense Energy Support Center, which provides fuel to government customers at more than 4,000 locations worldwide.[43] During fiscal year 2002, DESC purchased a total of 7.5 billion gallons of fuel, which was about 2 to 3 percent of that year's U.S. commercial consumption.[44] Although the transportation sector, with military transportation at its forefront, consumes massive

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38 Available at http://www.pbs.org/wgbh/pages/frontline/shows/saud/cron/ ; Internet; accessed on January 3, 2006.

39 15 of the 19 hijackers on the September 11, 2001 attacks on the US World Trade Center were from Saudi Arabia and numerous Saudi charities were linked to Al Qaeda. Klare, Michael T.; Blood and Oil: The dangers and consequences of America's growing petroleum dependency; Metropolitan Books; page 38. 2004.

40 Bin Laden thinks the price for oil should be $100 / barrel (he said it). He's also angry at the Arab's that bought their way into the white house. Syriana; Movie Reel; A &E Network; 1 hour; Television; Aired Saturday, December 10, 2005 at 5:00 pm.

41 Giannini, Robert M. and Le Pera, Maurice E.; Military Needs Efficient Fuel-Buying Process; National Defense Magazine; September 2004.

42 Giannini, Robert M. and Le Pera, Maurice E.; Military Needs Efficient Fuel-Buying Process; National Defense Magazine; September 2004.

43 Giannini, Robert M. and Le Pera, Maurice E.; Military Needs Efficient Fuel-Buying Process; National Defense Magazine; September 2004.

44 Giannini, Robert M. and Le Pera, Maurice E.; Military Needs Efficient Fuel-Buying Process; National Defense Magazine; September 2004.

amounts of petroleum, it is hardly the exclusive consumer of oil, and it is not the only sector subject to petroleum dependence's negative effects.

In 2003, the United States imported nearly $130 billion of energy-related petroleum products, accounting for over 1/4 of the $490 billion total US trade deficit in goods and services.[45] Our dependence on oil has resulted in the transfer of $1.16 trillion to oil-producing countries over the last three decades.[46] This transfer of wealth is expected to continue well into the near future. By 2025, US spending on imported crude oil and petroleum products are expected to increase to over $200 billion.[47] One might ask the impact of this statistic. The US Department of Energy estimates that each $1 billion of trade deficit costs the U.S. 27,000 jobs.[48] US dependence on the oil supplies and production facilities concentrated in the Persian Gulf make defense of this area a high priority for the US military. While there is no doubt that a major portion of the US military budget is used to protect our access to Persian Gulf oil, the magnitude of this value is difficult to determine. Analyst's estimates for the cost of maintaining an uninterrupted flow of oil from the Gulf region vary widely, from less than $0.5 billion to $70 billion annually.[49] This is equivalent to $0.015 to $0.30 per gallon of motor fuel obtained from Persian Gulf oil.[50] These estimates however do not include the cost of actual military action to defend our interests in the Persian Gulf. US military action in the 1990 Persian Gulf War cost the United States $61 billion, and not to make light of the

45 U.S. Census Bureau, Foreign Trade Statistics, Exhibit 1 and 17, March 2004.

46 Estimates provided by the Costs of Oil Dependence: A 2000 Update; Greene, D. and Tishchishyna, N., May 2000, Oak Ridge National Laboratory, Article. May 2000

47 EIA Annual Energy Outlook 2004, Figure 44

48 Available from http://www.energy.gov/ ; Internet; accessed January 2, 2006.

49 Conduct of the Persian Gulf War, U.S. Department of Defense, April 1992.

50 Estimates provided by Costs of Oil Dependence: A 2000 Update. Greene, D. and Tishchishyna, N., May 2000, Oak Ridge National Laboratory, May 2000

loss of precious human lives.[51] Over the last 30 years, oil dependence, including price hikes during supply disruptions and the transfer of wealth, has cost America an astounding $3.4 trillion.[52] Others have attempted to quantify this analysis with a hidden fuel price subsidized by the government of $1.276 per gallon.[53] It is now time to realize that petroleum is no longer a cost-effective energy source, but rather a costly venture that is unsustainable.

The United States can eliminate its oil dependence and revitalize its economy not by passing federal laws, taxing fuels, biasing markets, subsidizing favorites, mandating technologies, limiting choices, or crimping lifestyles, but by adopting smart business strategies.

51 Conduct of the Persian Gulf War, US. Department of Defense, April 1992.

52 Estimates provided by Costs of Oil Dependence: A 2000 Update. Greene, D. and Tishchishyna, N., May 2000, Oak Ridge National Laboratory, May 2000

53 John Amidon provides a hidden fuel price estimate in his article. Amidon, John, M.; America's Strategic Imperative: A "Manhattan Project" for Energy; Joint Force Quarterly; Issue 39; page 71; 4th Quarter 2005.

Analysis

It is obvious that we have an entrenched dependence on petroleum-based energy. So much so that our own government's National Energy Plan supports a deeper investment in petroleum.[54] But fortunately, the Bush administration's Advanced Energy Initiative peeks towards a more viable solution, although it is hardly the holistic solution needed.[55] A comprehensive plan with thrust has yet to be implemented because it is hard economically and politically to pull oil, the lifeblood, out of our lives. The next section analyzes our current situation and how a shift away from petroleum would affect those landscapes.

Al Qaeda and other enemies

The enemies of the United States are well aware that they cannot defeat our fielded military forces on the battlefield, so they turn their sights to a more vulnerable Achilles heal: our petroleum dependence. This paper is not suggesting any strategy be constructed solely on our enemy's plans nor should it be developed in a reactionary fashion, but if our strategy does not counter our enemy's plans, then it is unfortunately incomplete and lacking. For example, Al Qaeda realizes how deep our dependence on oil

54 National Energy Plan 2001 available from http://www.whitehouse.gov/energy/ ; Internet; accessed January 25, 2006.

55 Advanced Energy Initiative 2005 available from http://www.whitehouse.gov/news/releases/2006/01/20060131-6.html; Internet; accessed January 26, 2006.

goes, because it is outlined in Phase 4 of their grand strategy and ignoring this fact would be detrimental to any strategy development.[56]

"We are continuing in the same policy to make America bleed profusely to the point of bankruptcy"[57]

- Osama Bin Laden

Further, Bin Laden cited estimates that Al Qaeda spent $500,000 to carry out the attacks of September 11, 2001, which caused America to lose more than $500 billion. "Every dollar of Al Qaeda defeated a million dollars," bin Laden concluded. Oil, which jihadists call "the provision line and the feeding to the artery of the life of the crusader's nation," is a component of bin Laden's strategy.[58] Also, oil facilities and oil workers have been attacked around the world. In Iraq alone more than 190 attacks targeted oil pipelines.[59] Rising oil prices partly reflect the "fear premium" added by oil terrorism and for the US the spike in oil prices means a loss of over $50 billion in one year.[60] Because of oil's role in the War on Terror, the US stands to benefit enormously from reducing its dependence on petroleum.[61]

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56 Known to Al Qaeda as "The downfall." According to the plan, by 2013, Al Qaeda will control the Persian Gulf, and all its oil, as well as most of the Middle East. This will enable Al Qaeda to cripple the American economy, and A merican military power. Available from http://www.strategypage.com/dls/articles/20059240226.asp; Internet; accessed December 19, 2005.

57 October 2004 video, released just before the U.S. election, offers a glimpse into the jihadist strategy. Energy Security; Prepared by the Institute for the Analysis of Global Security; Al Qaeda's economic war against the United States; Available from http://www.iags.org/n0124052.htm; Internet; accessed on January 24, 2005.

58 Al Qaeda's energy strategy available from http://www.iags.org/n0124052.htm; Internet; accessed on November 11, 2005.

59 Al Qaeda' s energy strategy available from http://www.iags.org/n0124052.htm; Internet; accessed on November 11, 2005.

60 Al Qaeda's energy strategy available from http: //www.iags.org/n0124052.htm; Internet; accessed on November 11, 2005.

61 Energy Security; Prepared by the Institute for the Analysis of Global Security; Al Qaeda's economic war against the United States; Available from http://www.iags.org/n0124052.htm; Internet; accessed on November 11, 2005.

Infrastructure

A vast labyrinth of seaways, pipelines, railways, and highways make up the petroleum infrastructure. This system is equally responsible for our ability to fuel our energy requirements, as well as presents multiple vulnerabilities. This world network requires a tremendous amount of physical monitoring, and in some regions, physical security. The infrastructure used to deliver the precious crude is arguably the most vulnerable of all the links in the energy chain. If we were able to get away from our physical connection to the infrastructure, we could simply secure it through other than physical means (e.g. technological etc.). Wireless power transmission is one such means to disengage from our existing infrastructure, and it is offered as a possible solution to this problem later in the paper.

The existing infrastructure of the petroleum industry is vulnerable to intentional attack or unintentional incident. Regardless of the intended action it causes significant disruptions in our energy supplies. For example, the US light crude delivery for April 2005 jumped to $2.37, or roughly a 3 percent increase from March 2006, to trade at $62.91 a barrel on the New York Mercantile. This increase was directly a result of attackers trying to destroy an oil refinery in Saudi Arabia.[62] For comparison, the petroleum infrastructure is analogous to, as well as directly linked to, the US electrical grid. To distribute power, the US electric transmission grid consists of nearly 160,000 miles of high-voltage (230 kilovolts and greater) transmission lines.[63] Much like petroleum, the existing electrical grid simply wasn't designed to handle the current

demand. In March 18, 1989, links with Canada almost brought down Northeast US system all the way to Washington DC.[64] In 2002, the US Department of Energy was equally blunt when they stated, "There is growing evidence that the US transmission system is in urgent need of modernization." The system has become congested because growth in electricity demand and investment in new generation facilities have not been matched by investment in new transmission facilities. Those fears were realized in August 2003, when the grid failed during the blackout that hit the Midwest, Northeast and portions of Canada.[65] A series of power plants and transmission lines went offline because of instability in the transmission system in three states. The loss of these plants and transmission lines led to greater instability in the regional power transmission system. Within four hours, there was a rapid cascade of additional plant and transmission line outages and widespread power outages. The blackout affected as many as 50 million customers in the United States and Canada, as well as a wide range of vital services and commerce. Air and ground transportation systems shut down. Drinking water systems and sewage processing plants stopped operating. Manufacturing was disrupted and some emergency communications systems stopped functioning, in addition to petroleum refineries and service stations. These are examples of how vulnerable our oil infrastructure is, and if those vulnerabilities are exploited it translates into increased costs and/or profits lost as well as the close link between the electricity and petroleum infrastructure. Dispersed or distributed energy generation could be the solution to the problems that the existing infrastructure poses.

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62 Available from http://money.cnn.com/2006/02/24/markets/oil_attack/index.htm; February 24, 2006: 3:15 PM EST; Internet; accessed March 13, 2006.

63 Consumer Energy Council of America, Keeping the Power Flowing, January 2005.

64 MegaScience; The Science Channel; 1 hour; Television; Aired Friday, January 13, 2006 at 4:00 pm.

Dispersed / distributed energy generation uses a micro-turbine, solar cell bank, or windmill to power energy needs locally, with the bonus of selling the excess energy produced back to the local power utility.[66] It is effectively the same as having your own personal power plant at your residence. Although disbursed energy does not relinquish the user from dependence on a fuel source, unless that fuel source is renewable locally (e.g. wind, solar, biomass etc.), it does however solve the problem of providing energy to remote areas with little or no infrastructure, and limits the vulnerabilities existent in our current infrastructure.

Distributed generation at many locations around the grid increases power reliability and quality, while reducing the strain on the existing electricity transmission system. It also makes our electricity infrastructure less vulnerable to attack, both by distributing the generation and diversifying the power generation fuels. There have been numerous examples of these vulnerabilities of our energy infrastructure, with one such evidenced by Georgian President Mikhail Saakashvili accusing Russia of gas "sabotage" of the pipeline between Georgia and Russia.[67] A distributed energy approach would likely prevent these events in the future.

It is possible through distributed energy that everybody, or a significant number of consumers, could go off the grid entirely. This shift is already occurring around the globe. Dispersed, renewable electricity sources are the fastest growing sector in Europe.[68] Local windmills already provide 18% of Denmark's power and are on track to

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65 MegaScience; The Science Channel; 1 hour; Television; Aired Friday, January 13, 2006 at 4:00 pm.

66 Available from http://www.eere.energy.gov/de/; Internet; accessed September 18, 2005.

67 Available from http://www.msnbc.msn.com/id/10972979/\; Internet; accessed January 26, 2006.

68 Lovins, Amory B. and L. Hunter; Energy Forever; The American Prospect; Pages 30–34; Rocky Mountain Institute; 11 February 2002.

provide half in 2030.[69] In fact, wind power has lately added more megawatts worldwide than nuclear power averaged throughout the 1990s, and it dominates Europe's plan to make 22 percent of its electricity from renewable energy by 2010 (twice today's U.S. fraction).[70] According to government experts, wind power could cost effectively more than meet all of the world's electricity needs—or America's—at prices below 3 cents per kilowatt hour, as compared to 6 cents per kilowatt hour from our existing electricity sources in 2002.[71 and 72] Solar power is enjoying a similar boom, lately growing at a rate of 26 percent to 42 percent a year.[73] Although distributed energy solves significant problems in the infrastructure, it does not solve problems as a result of the transportation sector.

More than 75% of the goods delivered in the United States travel by truck, which is highly dependent upon the petroleum infrastructure and the cost of petroleum.[74] A few cents of increase in oil prices translates to truckers having the inability to afford operating their vehicles, a subsequent prevention of delivery of goods and services, and ultimately a decline in the overall economy.

The current infrastructure is directly related to providing petroleum from its source directly to the consumer for consumption. However, there are some positive efforts and changes to the infrastructure that utilize alternative fuel sources such as hydrogen or ethanol. Despite more alternative fuel stations and the associated infrastructure appearing in the US, their quantity is still miniscule when compared to the

69 Willrich, Mason; Energy and World Politics; The Free Press; page 104;1975.

70 Willrich, Mason; Energy and World Politics; The Free Press; page 104;1975.

71 Available from http://www.eia.doe.gov/neic/infosheets/electricityprices.htm; Internet; Accessed February 26, 2006.

72 Willrich, Mason; Energy and World Politics; The Free Press; page 104;1975.

73 Willrich, Mason; Energy and World Politics; The Free Press; page 104;1975.

existing petroleum infrastructure.[75] This category of disengagement from petroleum is a step in the right direction, but simply needs to be expanded.

Environmental Impacts

In addition to the threats that petroleum dependence generates, there are huge disadvantages realized in the environment as well. All of which directly relate to health care costs, global warming, and ultimately back to our economy.

Transportation is the largest single source of air pollution in the United States.[76] Harmful pollutants in motor vehicle emissions include carbon monoxide, nitrogen oxides, volatile organic compounds, sulfur oxides, particulates and toxic gases such as benzene.[77] Unfortunately, two decades of legislation in California have not made cars any more efficient, but it has cleaned up pollution.[78] In addition, ozone, the primary ingredient in smog, is created when hydrocarbons and nitrogen oxides react with sunlight.[79] There are a variety of health problems related to exposure to these substances, ranging from eye irritation, to respiratory and cardiovascular illnesses, to cancer. For example, ozone pollution is responsible for 10% to 20%, and nearly 50% on bad days, of all hospital

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74 CBS Up to the Minute; 2 hours; WKTR- Norfolk; Television; Aired Monday, March 13, 2006 at 4:22 am.

75 Available from http://afdcmap.nrel.gov/locator/LocateResult.asp; Internet; accessed March 13, 2006.

76 Available from the Environmental Protection Agency at http://www.epa.gov/ebtpages/humanhealth.html ; Internet; accessed on February 20, 2006.

77 Available from the Environmental Protection Agency at http://www.epa.gov/ebtpages/humanhealth.html ; Internet; accessed on February 20, 2006.

78 In the 1960s it took about 210 grams of fuel to move a car 1 mile, of that 10 grams were unburned hydrocarbons per mile. Since the 1960s, a typical car requires 110 grams to get 1 mile and about 2.5–3 grams of unburned hydrocarbons, but the catalytic convert reduces it to .4 gram per mile (96 percent in reduction) Assignment Discovery; The properties and uses of aluminum, indium, tin, lead and other metals; Discovery Channel; 1 hour; Television; Aired Thursday December 15, 2005 at 5:00 am.

79 Available from the Environmental Protection Agency at http://www .epa.gov/ebtpages/humanhealth.html ; Internet; accessed on February 20, 2006.

admissions for respiratory conditions.[80] Additionally, the Environmental Protection Agency estimates that air toxics emitted from motor vehicles account for half of all cancers caused by air pollution.[81]

Consequently, enormous hidden public health costs come with the transportation sector's use of oil. Economists term these costs externalities because they are not included in the private cost of transportation. A 1997 Congressional Research Service report estimates that $4 billion, or $0.05 per gallon of gasoline, is the additional cost due to ozone-related respiratory health problems, and that tens of billions of dollars, or $0.59 per gallon of diesel, is the additional cost due to morbidity and premature mortality caused by particulates and acidic aerosols.[82] The Union of Concerned Scientists estimates that public health costs due to air pollution account for over three-quarters of the total pollution-related public health costs and could be as high as $182 billion annually.[83] Reducing the amount of petroleum fuels we use and replacing them with cleaner-burning sources will decrease air pollution and related public health costs.

Joan Ogden of the University of California, Davis determined that even a super advanced gasoline-burning car over its lifetime causes an average of $1,162 in health-related damage associated with air pollution.[84] By Ogden's calculations, the cost of pre-tax gasoline is around $2.00 per gallon. By comparison, the cost of a hydrogen fuel cell for the same amount of energy would be $2.41 per gallon. Based on this analysis,

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80 Oil Slickers: How Petroleum Benefits at the Taxpayer's Expense. Wahl, J., 1996, Institute for Local Self Reliance

81 Available from http://www.epa.gov/ebtpages/humanhealth.html ; Internet; accessed February 1, 2006.

82 Oil Imports: An Overview and Update of Economic and Security Effects, Moore, J. et al., December 12, 1997,CRS Report for Congress 98-1

83 "Subsidizing Big Oil," 2000, Union of Concerned Scientists

84 Roberts, Paul; The End of Oil: On the Edge of a perilous new world; Houghton Mifflin Company; Boston and New York; page 275; 2004.

hydrogen fuel cells are finally within striking distance of being competitive with gasoline, especially as the price of gasoline increases above and beyond $3.00.

Further, decreases in demand can be achieved through choice, by taking the bus for example. Each bus in New York City gets 40 cars off the roads.[85] A concerted effort to reduce personal consumption through the automobile and convert to mass transit would significantly decrease the demand for oil. Conservation is also a way to reduce environmental problems and/or extend the time to deal with them. 90% of man-made carbon dioxide comes from the burning of gas, oil, and especially coal. Further, gas, oil, and coal provide more than 85% of the world's energy.[86] We cannot fix our climate problem without making substantial changes to our energy consumption. The burning of petroleum is literally wrecking havoc on our earth's ecosystem.

Global warming may be the biggest problem facing the world today. We have not put much credence in the environmentalist's alarming claims, but there is now evidence that we are literally contributing to our own demise. The end of the last ice age was triggered by an increase of only three degrees, which took 5000 years.[87] Whereas in less than a century we have shrunk the polar ice caps by 15%, resulting in a ten-inch rise in sea level, and a widespread retreat of glaciers.[88] More hurricanes, droughts, and tropical diseases are likely caused by the fact that our last decade was reported as the hottest in

85 Understanding; Car Travel becomes increasingly hazardous; The Science Channel; 1 hour; Television; Aired, Friday February 3, 2006 at 5:00pm.

86 Roberts, Paul; The End of Oil: On the Edge of a perilous new world; Houghton Mifflin Company; Boston and New York; page 118; 2004.

87 Roberts, Paul; The End of Oil: On the Edge of a perilous ne w world; Houghton Mifflin Company; Boston and New York; page 118; 2004.

88 Roberts, Paul; The End of Oil: On the Edge of a perilous new world; Houghton Mifflin Company; Boston and New York; page 120; 2004.

1000 years.[89] In 2005, researchers analyzed data from Canadian and European satellites and found that the Greenland ice sheet is not only melting, but also doing so faster and faster. Specifically, 53 cubic miles have drained away into the sea last year alone, compared to 23 cubic miles in 1996. [90] Melting polar ice accelerates global warming because the white ice typically reflects the sun's rays, rather than the blue ocean water retaining their heat. When the preponderance of ice vs. water shifts, the temperature rise will accelerate. Most scientists believe that such examples have contributed to global warming and have already caused irreversible tipping events that will accelerate the process. It is believed that the number one contributor to global warming and ultimately our failing eco-system is the significant parts per billion of hydrocarbons and carbon dioxide introduced into the environment by burning petroleum products. This problem has the potential of being worse than any weapon of mass destruction developed by man to date. Some call this a sensationalist categorization of the problem, but the fact is the trend is towards an increased use of petroleum rather than a decrease, which will only further accelerate the effects of global warming, and ultimately threaten our very survival.

The international community has made some progress towards curbing our global warming through the Kyoto protocol, where the US agreed in 1990 to cut carbon dioxide emissions by 7%.[91] However, the US planned to accomplish this by getting credit for forests, which essentially sequester carbon dioxide, and by buying credits from other countries (e.g. Russia's collapsed economy reduced their emissions by 1/3 and the US

89 Discovery Times Channel; The color of oil: power profits, and the environmental movement; 1 hour; Television; Aired Wednesday, January 4, 2006 at 10:00 am.

90 Available from http://www.cnn.com/2006/US/03/26/coverstory/index.html ; Internet; accessed March 27, 2006.

can buy carbon emission credit from them). Ultimately, the US was not reducing any more emissions and effectively nullified the efforts that the Kyoto protocol attempted to achieve.

According to the UN's Intergovernmental Panel on Climate Change, if we have any hope of keeping our atmospheric carbon dioxide concentrations below dangerous levels, one seventh of all our energy must originate from a new, carbon-free energy by no later than 2030. By 2050 that share must be nearly one-third, and by 2075 more than half.[92] Conservation and protecting our environment are critical to a long-term solution to curbing our insatiable appetite for petroleum-based energy, although for most it seems to be over the horizon, and thus not considered as part of the solution. However, it can enhance our economic gain, political influence, and ultimately sustain the human race.

Existing Energy Alternatives

Some say that Wall Street investors are skeptical of renewable energy stocks because of their uncertainty. In the past two years, the worldwide stock-market value of companies developing renewable energy—which includes everything from wind and solar to recycling—fell from $13 billion to $10.7 billion, while the value of fossil-fuel companies surged to record highs of more than $1.2 trillion.[93] Regardless of the skepticism of investors, any solution to petroleum independence must involve renewable alternative energy sources. We are aware that petroleum is not renewable in our lifetime,

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91 Roberts, Paul; The End of Oil: On the Edge of a perilous new world; Houghton Mifflin Company; Boston and New York; page 128; 2004.

92 Roberts, Paul; The End of Oil: On the Edge of a perilous new world; Houghton Mifflin Company; Boston and New York; page 190; 2004.

93 Available from http://msnbc.msn.com/id/5963503/site/newsweek/; Internet; accessed March 13, 2006.

which ultimately leads to its demise as an energy solution for our future. As a result, we must actively pursue alternate renewable energy sources.

There are already documented successes in renewable energy, despite skepticism to the contrary. In 2005, the Air Force purchased more than a million megawatts of energy derived from wind, solar, geothermal, and other renewable energy sources. This million-plus megawatt total represents a threefold increase over the 2004 amount, and is enough energy to power the needs of 70,000 average-size homes for an entire year.[94] The Air Force is the largest purchaser of renewable energy in the United States with 11 percent of the electricity it purchases coming from renewable energy sources. Edwards Air Force Base, CA, is the largest purchaser of renewable energy, with 138 million kilowatt hours of power purchased each year - enough to satisfy 60 percent of its electrical needs. Further, the Air Force has reduced its energy use by 30 percent since 1985 and 25 percent of the Air Force's vehicle fleet are flex-fuel capable vehicles.[95] Through leadership and the advantage of gaining efficiencies and saving money, the Air Force is a prime example of how alternative energies are cost effective.

When discussing alternatives to petroleum-based energy it is important to categorize them into primary and secondary renewable sources. A primary renewable resource is one that has an apparently infinite cycle of regeneration. An example of this would be nuclear fusion reaction like that of the sun. It is conceded that the sun has a finite lifecycle of billions of years, but as long as the sun is burning, life will continue to

94 Available from http://www.af.mil/news/story.asp?id=123016926; Internet; accessed March 13, 2006.

95 Available from http://www.af.mil/news/story.asp?id=123016926; Internet; accessed March 13, 2006.

exist from the energy it produces.[96] A practical example of a primary energy source is the fusion reaction technology that slams particles together and controls the explosion via extremely powerful magnetic or laser fields. A secondary renewable resource has a limited or finite cycle of renewability. An example of this would be ethanol fuel that is achieved from growing cellulose crops. The life cycle of the crops is much shorter and requires the inputs of water, nutrients, and sunlight to be sustainable and renewable. Figure 3 illustrates this categorical relationship.

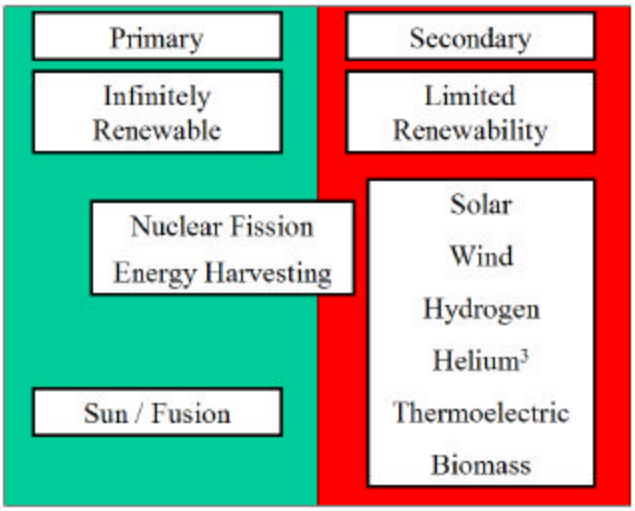

Figure 3, Renewable / Alternate Energy Sources[97]

Regardless of the specifics of the energy source of choice, new energy sources would take a comparative similarity to the Manhattan Project for nuclear development, and it simply could not be accomplished without government support. The next section

96 Estimates are that the Sun will last for 5 billion years or more available from http://www.madsci.org/posts/archives/mar97/853714295.Ph.r.html; Internet; accessed November 22, 2005.

97 Developed by the Author

will discuss possible long-term energy source alternatives to petroleum that are technologically feasible, economically profitable, environmentally friendly, and are already in existence.

Nuclear Fission

Nuclear power can be categorized as an energy source that straddles the primary and secondary renewable energy sources because it produces large amounts of energy, yet the source of that energy is non-renewable uranium. Further the potential environmental hazards with regards to the radioactive waste material produced have lost popular favor in the last 30 or so years. Nonetheless, in our new political landscape it is emerging as a viable solution to our petroleum dependence. For nuclear power to be viable in the long-term it will require breeder reactors because low cost uranium resources used to power the reactors would be expelled in just a few decades.[98]

Nuclear Fusion

The National Ignition Facility (NIF) Project is remarkably close to producing a controllable nuclear fusion reaction.[99] The NIF's arena-sized building houses 192 laser beams designed to deliver 1.8 million joules of ultraviolet laser energy and 500 terawatts of power to millimeter-sized targets located at the center of its 10-meter-diameter target

98 Breeder reactors produce more fissionable material than they consume .Willrich, Mason; Energy and World Politics; The Free Press; page 49; 1975.

99 Available from http://www.llnl.gov/nif/project/index.html ; Internet; Accessed April 10, 2006.

chamber. This laser is specifically designed to cradle a nuclear fusion reaction or a proverbial "sun" right here on earth. This energy source, when controlled, approaches the ideal of an infinite source with the byproduct of water.

Solar / Wind / Other Alternatives

The sun has always been and will continue to be the ultimate energy source that sustains life and powers the natural environment. As a result, photovoltaic cells and windmills simply convert the sun's energy and are categorized as a secondary energy sources. These sources are renewable and environmentally friendly, which contribute to the long-term solution of our energy problem.

In one example, a promising wind generation application is the vertical axis wind turbine called the Turby, which was specifically developed for rooftops on high-rise buildings. It is a small, transparent, low noise, vibration-free, low maintenance, and it installs without need for crane for under $10,000.[100] This type of windmill could change the paradigm for wind energy that you need wide open windmill farms. Further, solar panels are now being made of flexible material that make its installation possible on virtually any flat surface and molded to that surface.[101] It's innovations like these that facilitate a wider use of these renewable energy sources.

100 Available from http://www.opensourceenergy.org/C17/News%20Viewer/defa ult.aspx?ID=1075; Internet; accessed March 13, 2006.

101 Available from http://www.solarpowergetics.com/servlet/the-151/Solar-Transparent-Nanofilm/Detail ; Internet; accessed March 13, 2006.

Hydrogen

Hydrogen fuel sources are also categorized as secondary energy. At the vanguard of this energy insurrection is the hydrogen fuel cell, a 150-year old energy technology that is clean, quiet, and nearly 3 times as energy-efficient as even the best internal combustion engine.[102] However, hydrogen must be obtained by using some other energy source. Usually it is obtained by the electrolysis of water, or by breaking down natural gas (methane or CH_4). Effectively a fuel cell is a self-charging battery that runs off hydrogen with the next generation fuel cell being the biofuel cell.[103] These cells are considerably smaller and may range from microbially sustained cells at the seawater/sediment interface or in waste streams, to highly engineered bioanodes and biocathodes using redox enzymes. All of this is accomplished with zero emissions. However, as promising as fuel cells powered by hydrogen seem, on the consumption side, the theoretical case assumes 100% conversion of hydrogen to electricity, whereas the best fuel cells convert only 70% of the energy required to generate hydrogen.[104] This case ignores the energy demand to separate the greenhouse gas CO_2 from the product stream, as well as the energy consumed to transport and compress the CO_2 for sequestration. Finally, the theoretical case ignores the energy to compress the product hydrogen to a sufficiently high pressure for storage (A thermodynamic calculation shows

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102 Roberts, Paul; The End of Oil: On the Edge of a perilous new world; Houghton Mifflin Company; Boston and New York; page 68; 2004.

103 Office of Naval Research: Energy harvesting available from http://www.onr.navy.mil/sci_tec h/personnel/341/bbb_energy.asp; Internet; accessed on September 10, 2005.

104 Standing, Tom; Making Hydrogen?; Oil & Gas Journal; April 14, 2003.

that about 20% of the energy value of hydrogen would have to be expended to compress it to 4,000 psi).[105] Nonetheless, it is still a viable existing secondary energy alternative.

Biomass

Biomass is fuel developed from manure, waste organic materials, or crops grown for the purpose of providing fuel. We currently have proven concepts in biodiesel (e.g. Ethanol 85) that are already infused into our energy infrastructure.[106] These sources of energy are environmentally friendly and economically feasible alternatives to petroleum. There are also algae organisms that convert waste into hydrogen, methane, or other fuel sources.[107] The biomass category of fuel source could easily allow for an affordable alternative to petroleum and could facilitate our transition to petroleum independence.

Conservation and Efficiency

The United States already has a readily available energy source equivalent to all of the Saudi Arabian oil fields. However, we do not appreciate this resource because this energy source is in the form of lost waste.[108] Willrich contends that the most efficient way for the world to use energy resources is literally the cheapest.[109] Although it is difficult to sell that concept to the business and government sector because this approach requires a long-term commitment rather than a short-term fix. One such profitable

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105 Standing, Tom; Making Hydrogen?; Oil & Gas Journal; April 14, 2003.

106 Available from http://www.e85fuel.com/e85101/flexfuelvehicles.php; Internet; accessed on February 7, 2006.

107 Available from http://www.unh.edu/p2/biodiesel/article_alge.html and http://homedistiller.org/wiki/index.php/Alcohol_fuel; Internet; accessed February 4, 2006.

108 Street Signs; CNBC; 1 hour; Television; Aired Wednesday February 1, 2006 at 2:15 pm

109 Willrich, Mason; Energy and World Politics; The Free Press; page 104;1975.

example of efficiency is evidenced by the growth of the hybrid automobile market and the declining sales in the SUV market.[110] Although the hybrid sector is a promising vector towards conservation and efficiency, it requires more effort by business and government to truly gain economic favor.

Efficiencies in the industry can be achieved through brute government regulation, but this method is extremely costly and ineffective. Instead of governments blindly regulating towards a preferred energy source using traditional bureaucratic practices, a true change will only occur by market driven factors in the private sector with stimulus and incentives from government like feebates for new cars and light trucks.[111] Thus, the markets and industries will reinvent themselves to stay competitive in the emerging energy markets. A domestic example of profitable efficiency is how Americans in the 1979 oil shortage cut oil use 15 percent in six years, while the economy grew 16 percent.[112] Further, Californians cut electricity demand by 14 percent in a six month period abruptly ending a state-wide energy crisis that the White House claimed would require 1,300 to 1,900 more power plants nationwide to solve.[113]

Another option to increase conservation and efficiency is to raise the CAFE standards for automobiles.[114] It is believed that just a 2.7-mpg gain in the fuel economy

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110 SUV markets weakening markets available from http://money.cnn.com/2004/05/17/pf/autos/suvs_gas/ ; AND http://www.greencarcongress.com/2005/05/sales_of_fullsi.html AND http://www.post-gazette.com/pg/05076/472585.stm AND http://www.washingtonpost.com/wp-dyn/content/article/2005/12/01/AR2005120100737.html Internet; accessed January 11, 2006.

111 Feebates combine fees on inefficient vehicles with rebates on efficient ones, to influence consumer choice. Lovins, Amory B.; How America Can Free Itself of Oil—Profitably; FORTUNE Magazine. Copyright 2004 Time Inc; October 4, 2004.

112 Provided by Lovins, Amory B.; How America Can Free Itself of Oil—Profitably; FORTUNE Magazine. Copyright 2004 Time Inc; October 4, 2004.

113 Lovins, Amory B. and L. Hunter; Mobilizing Energy Solutions; The American Prospect; Pages 18–21; Rocky Mountain Institute; 28 January 2002.

114 CAFE information available from http://www.ita.doc.gov/td/auto/cafe.html ; Internet; accessed January 4, 2006.

of this country's light-vehicle fleet could displace Persian Gulf imports entirely.[115] This is the type of incremental efficiency that we're attempting to gain in order to stimulate the economy and gain US petroleum independence. Fortunately, the Bush administration has recently raised the CAFE standards and incorporated the inclusion of the SUV and pickup truck markets. The new fuel economy rules, covering 2008 through 2011, would save 10.7 billion gallons of fuel over the lifetime of the vehicles sold during that period.[116] Although these actions by government are the most aggressive in the 27-year history of the standards, we simply can, and must, do more in this area.

Another way to increase efficiency is to lower the gross weight of automobiles. [117] Lower overall gross weight of a vehicle lessens energy required to propel it down the road.[118] In 2000, Hypercar designed a producible, competitive-cost, midsize-SUV concept car made of ultra-light carbon fiber composite. This vehicle can also absorb up to five times more crash energy per pound than steel, and it achieves the equivalent of 99-mpg.[119] Other manufacturers boast u ltralight, ultrastrong carbon-fiber composite autobodies yielding 66-mpg hybrid SUVs and 92-mpg hybrid cars.[120] By 2020 the thirstiest cars on the planet could be gone for good, which will ultimately contribute to a significant decrease in petroleum demand. In addition to reducing the weight of vehicles, we could take a conservation lesson from our allies.

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115 Lovins, Amory B. and L. Hunter; Energy Forever; The American Prospect; Pages 30–34; Rocky Mountain Institute; 11 February 2002.

116 Available from http://www.msnbc.msn.com/id/12063888/ ; Internet; accessed April 10, 2006.

117 The typical American car weighs 2800 lbs. and 2000 lbs of that is steel. Assignment Dis covery; The properties and uses of aluminum, indium, tin, lead and other metals; Discovery Channel; 1 hour; Television; Aired Thursday December 15, 2005 at 5:00 am.

118 For every 100 lbs of weight mileage can be improved by approximately 1-mpg. Assignment Di scovery; The properties and uses of aluminum, indium, tin, lead and other metals; Discovery Channel; 1 hour; Television; Aired Thursday December 15, 2005 at 5:00 am.

119 Lovins, Amory B. and L. Hunter; Energy Forever; The American Prospect; Pages 30–34; Rock y Mountain Institute; 11 February 2002.

In Europe there is now a market to trade carbon.[121] That is to say, a company in Denmark can trade its emissions reductions gained with another company in Germany, thus meeting the higher European emission reduction standards. The model has taken off and is the hot new commodity. When the government creates a shortage of supply (cap on emissions) the market tries to meet that cap. In 2002, BP actually saved $600 million by cleaning up its emissions via the carbon emissions trade market.[122] This example provides policy makers concrete evidence that it is economically feasible to be efficient, and that it can be accomplished at financial gain through markets.

Efficiencies have also been gained from re-generation technology or the recapture of waste heat. The technology to cleanly and quietly turn heat into electricity without the use of a turbine or generator has existed for nearly a century. A pair of scientists at the Massachusetts Institute of Technology and Eneco Inc., made a device that nearly doubles the amount of electricity that can be extracted from heat.[123] The researchers' thermal diode converts about 18 percent of thermal energy to electricity, while current thermoelectric generators convert about 10 percent.[124] The technology could be used to generate additional electricity from power plants, which throw off enormous amounts of waste heat, and to generate electricity from the waste heat of automobile engines and exhaust. To place it in perspective, the waste heat from America's existing power plants

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120 Lovins, Armory B.; Ending our oil dependence; The Ripon forum; Volume, 39; Number II; page 13; March/April 2005.

121 Discovery Times Channel; The color of oil: power profits, and the environmental movement; 1 hour; Television; Aired Wednesday, January 4, 2006 at 10:00 am.

122 Discovery Times Channel; The color of oil: power profits, and the environmental movement; 1 hour; Television; Aired Wednesday, January 4, 2006 at 10:00 am.

123 Patch, Kimberly; Chips turn more heat t o power; Technology Research News; Available from http://www.trnmag.com/Stories/2001/121901/Chips_turn_more_heat_to_power_121901.html; Internet; accessed on October 12, 2005.

124 Lovins, Amory B. and L. Hunter; Energy Forever; The American Prospect; Pages 30–34; Rocky Mountain Institute; 11 February 2002.

is equivalent to the energy that the entire country of Japan consumes over the same time.[125] In principle, re-generation could cut America's total fuel usage by one-third, halve net generating cost, and save a trillion dollars per decade if it were implemented as they do in Europe.[126]

Another example of profitable efficiency and conservation is Manhattan's Condé Nast Building, which was designed to use half the energy of an ordinary office building. With the saved construction costs, the developers were able to equip it with the two most reliable known power sources: fuel cells and solar cells.[127] This distributed/dispersed electricity production helped them win in the real-estate market by recruiting premium tenants quickly at more affordable rents.

The entire Department of Defense is also getting serious about its dependence on oil and discussing actions related to conservation and efficiency.[128] In March 2006 they began the first in a series of seminars organized by the Pentagon's Office of Force Transformation and Acquisition Office, to wean the United States off its addiction to oil. Jim Woolsey, the former CIA director and keynote speaker of the seminar, describes a plan with all the aforementioned elements that could eventually achieve gas mileage of about 1,000 miles a gallon. This plan was not laid out like a Manhattan Project-like scheme, but rather incremental improvements in conservation that can be implemented within months to a few years, rather than several years or decades. These and other

125 Lovins, Amory B. and L. Hunter; Energy Forever; The American Prospect; Pages 30–34; Rocky Mountain Institute; 11 February 2002.

126 Lovins, Amory B. and L. Hunter; Energy Forever; The American Prospect; Pages 30–34; Rocky Mountain Institute; 11 February 2002.

127 Lovins, Amory B. and L. Hunter; Energy Forever; The American Prospect; Pages 30–34; Rocky Mountain Institute; 11 February 2002.

128 Available from http://www.airforcetimes.com/story.php?f=1-292925-1649990.php ; Internet; accessed April 10, 2006.

innovative ways to conserve energy, by providing more efficient uses, have proven profitable, practical, and necessary to our continued prosperity.

Economic

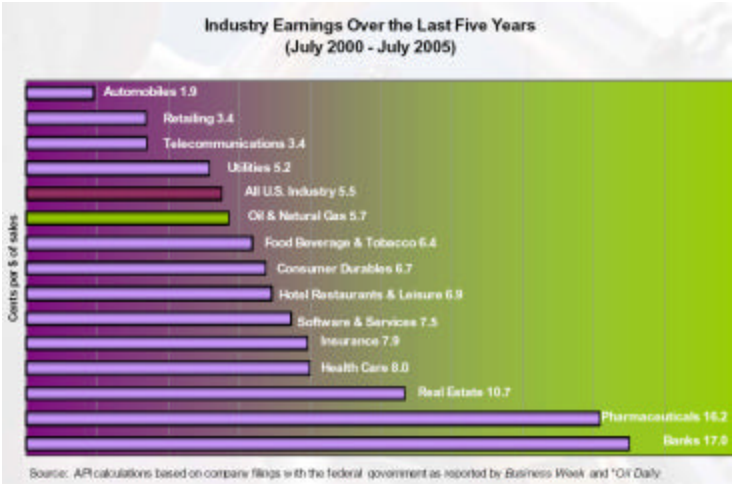

Figure 4, US Industry Earnings[129]

The oil industry is one of the major industries in the world. Figure 4 delineates the earnings of the major US industries. What is not immediately evident in the figure is how the oil industry enables virtually all of the other industries, worldwide. Simply stated, consumer goods and services arrive by our transportation system (e.g. rail or truck), which is fueled by petroleum. Yergin and Manning refer to this as the expansion of market forces and interdependence, as nations link their fates to one another through pipelines, grids, and cross investment. This interdependence is not all negative, because Harris sees the globally integrated energy markets as an opportunity for fuel substitution,

129 Charts available from http://api-ec.api.org/filelibrary/KatrinaSlides.pdf ; Internet; accessed on December 7, 2005.

lower-priced energy, and improved energy efficiencies. Regardless of how this interdependence is characterized, its existence cannot be denied.

The petroleum industry has fueled our economy, both figuratively and literally. A divestment from petroleum-based energy has never occurred because it hasn't made financial and economic sense…yet. This paper argues that the conditions for the paradigm shift from petroleum dependency are now appropriate and makes more sense than ever before. The shift is already occurring on a smaller scale in the automobile industry, where the hybrid segment is experiencing growth.[130] This is evidenced by Toyota's 3rd quarter profits increase of 34% in US and Asia sales, nearly eclipsing number 1 world automaker General Motors, with even more growth potential projected. [131 and 132] Further, the dwindling gas guzzling SUV market segment is experiencing a decline primarily due to higher oil prices.[133]

There is no such ideal as free energy in this world. There are some optimists that would have you believe that energy sources like hydroelectric and solar power are free energy. However, we still manage to charge for those energy sources either through infrastructure, taxes, metered use of the energy, introductory capital costs or all of the

130 Hybrid cars still make up a very modest portion of the U.S. car market available from http://www.abcnews.go.com/Business/Technology/story?id=1566135; Internet; accessed February 12, 2006.

131 Toyota's sales rose 15 percent, which was attributed to some help from the weaker Japanese yen which inflated the value of overseas revenues, but in truth they were achieved from surging fuel prices and the subsequent demand for compact cars and the Toyota Prius hybrid. They are also predicting record profits for full year report. Available from http://abcnews.go.com/Business/wireStory?id=1588361; Internet; accessed February 11, 2005.

132 Annual survey conducted by consulting firm KPMG, found that 88 per cent of car makers believe the market share of gas-electric hybrids will continue picking up speed over the next five years. Available from http://www.ctv.ca/servlet/ArticleNews/story/CTVNews/20060104/hybrid_survey_060104/20060104?hub=TopStories; Internet; accessed January 26, 2006.

133 Weakening SUV sales available from http://money.cnn.com/2004/05/17/pf/autos/suvs_gas/; AND http://www.greencarcongress.com/2005/05/sales_of_fullsi.html AND http://www.post-gazette.com/pg/05076/472585.stm AND http://www.washingtonpost.com/wp-dyn/content/article/2005/12/01/AR2005120100737.html Internet; accessed January 11, 2006.

above. Although using the descriptor "free" is not appropriate in this discussion, there are other appropriate, relevant descriptors like renewable, efficient, and alternative. This paper proposes a business case for the energy industry and enabling industries to transition away from petroleum-based energy. Ultimately, it is more cost effective than continuing along the futile path of dependence by proposing real advantages that boost their profit and contribute to overall growth in the economy. It is not difficult to make the link between energy and our economy, as they are mutually dependent upon each other.

Energy security is closely linked to economic security. In order to maintain our own economy's success, we must protect, if not control, access to the world's petroleum. A divestiture in petroleum-based energy by the US and its allies will lower the price of petroleum because of the economic laws of supply and demand. As we transition towards a lower demand, the price will lower accordingly, and will actually make the transition profitable. Brazil is an excellent example of achieving long-term petroleum independence through the economic laws of supply and demand. They converted to a biomass (e.g. ethanol) fuel market powered by sugarcane. However, it did not come without large capital investment. Their government financed an enormous distribution network to get the fuel to the stations and subsidized the industry heavily to change the market. Now Brazil's investment is paying off and the country is less dependent on oil, its consumers pay less to fuel their vehicles, and it's the world's largest exporter of ethanol fuel.[134]

134 Street Signs; CNBC; 1 hour; Television; Aired Wednesday February 1, 2006 at 2:15 pm

As more examples of how petroleum independence can actually stimulate an economy are realized, we will be able to divest from petroleum dependence altogether, and we may be able to bolster our political standing that has been eroded by our national interest and preoccupation with oil security.

Political

Since the end of the Cold War, the US has emerged as the sole Superpower. The New World Order was hoped to end international disputes, however we have seen as much armed conflict in the post-cold-war era as we saw earlier, and in some respects the world has become more dangerous. With the title of sole superpower comes a level of responsibility for the US, as well as resentment towards us. We have engaged in political partnerships to maintain our power base, but unfortunately these relationships had second and third order effects that created resentment towards our country. Control for energy resources has resulted in relationships and alliances that otherwise might not have occurred (e.g. Saudi and US). There are some in the world that resent our economy, and others resent our position of power in the international community. Regardless of the source of resentment, any successful action by our enemies to capitalize on this resentment would result in misfortune for the US.

To date we have been trying to solve our petroleum import, security, and military issues with the chess pieces that are on the board; which are finite. Our approach regarding oil resources has only positioned more adversaries against us, regardless of how effective our overall international humanitarian support or financial aide has been. Despite how we position the chess pieces, it only trades one set of circumstances for

another.[135] What we really need to do is play on an entirely new chessboard with new chess pieces; ultimately this means playing an entirely new game.

As with most issues, politics are interwoven throughout. The same is true with energy politics. The world map of energy politics is dominated by 5 major players: 1) Developing Countries 2) European Energy politics 3) Energy suppliers 4) United States 5) and everybody else.[136] It's important to keep these categories in mind when dealing with energy in the political arena. For example, China and Russia, are seeking additional oil from many of the same suppliers as the US, and are just as willing as we are to meddle in the local and regional security affairs, which could lead to a deadly confrontation between the world's major military powers.[137] Further, Exxon and Chevron recently lost a bid for Nigerian oil fields to a Korean state-run company. This demonstrates that the competition that used to be exclusive to business and markets is now expanded to state-run companies, representing a new breed of competitors who drive up costs and add a new level of complexity to acquiring petroleum sources.[138]

Some believe our issues associated with this problem are a result of the clash of civilizations (ethnic, religious, clan etc.). Yet others believe it was a result of the US partnership with Muslim nations like Saudi Arabia, and United Arab of Emirates. After examining a number of recent wars in Africa and Asia, Klare believes resources, not

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135 Each year since 1999 in the fall a group of experts on energy and international relations has met with a handful of US intelligence officials entitled Geopolitics of Energy in 2015 because energy affects global stability and global stability is key to American security. Roberts, Paul; The End of Oil: On the Edge of a perilous new world; Houghton Mifflin Company; Boston and New York; page 307; 2004.

136 Roberts, Paul; The End of Oil: On the Edge of a perilous new world; Houghton Mifflin Company; Boston and New York; page 287; 2004.

137 An example of this power struggle was published on 11 Jan 2005 by India Daily. Panicked India goes after Iranian, Russian and American Energy Assets competing directly with China. ID staff reporter.

138 Bloomberg Television; 1 Hour; Television; Aired February 7, 2006, at 6:00am

differences in civilizations or identities are the roots of most contemporary conflict.[139] In Angola and Sierra Leone, it was the control of the diamond fields, in the Congo, gold and copper, in Borneo and Cambodia, the struggle was for timber. Ethnicity and religious undertones have antagonized these clashes, but this was usually exercised as a mobilizing ploy. Petroleum is unique of all these resources (originally believed to be no more significant than timber or gold) because it has more potential to provoke conflict than any of the others.

American policy makers in recent history have felt compelled to do whatever was necessary, to ensure enough cheap energy was available, especially in the political arena. Having the ability to treat countries with oil the same as countries without oil, and no longer giving anyone cause to think US actions are about oil, would help defuse global suspicions and conflicts.

Would cutting off the dependence of Persian Gulf oil be any less politically challenging than what we have to go through now to ensure security in the region? It has been very difficult to gain favor with, and help out those regimes, while avoiding the appearance of intrusion into local affairs. Perceived or real instability in the Gulf is a security problem that we haven't been able to solve yet, and it appears to be insolvable. The future of global security, or insecurity as it may be, will be fueled by the fact that there is a large pool of disenchanted and disenfranchised youth that believes their only means of influencing the world is through extreme violence. For example, in Saudi Arabia, 75% of the population is under 30. Coupled to this population is a drop in per capita income from $28,600 in 1981 (roughly equivalent to US) to a mere $6,800 in

139 Klare, Michael T.; Blood and Oil: The dangers and consequences of America's growing petroleum dependency; Metropolitan Books; page 47; 2004.

2001. This situation is further exacerbated with a sharp increase in the unemployment rate of young, college-educated men to more than 30 percent whereas it was zero a decade earlier.[140] In Iran and Iraq the same situation exists with 65% of their populations under 25 and similar income and unemployment woes are observed.[141] This combination of educated, disenfranchised, religiously zealous youth will prove to be a security risk for years to come and a political challenge that appears to be unsolvable.

The 2001 National Energy Policy lists that our only future energy options are to increase the petroleum supply via the Alternative Eight countries.[142] However five of the Alternative Eight (Angola, Azerbaijan, Colombia, Nigeria, and Russia) have undergone civil wars or ethnic conflicts in recent years, the other three (Kazakhstan, Mexico, and Venezuela) have had riots, strikes, or other forms of political disorder.[143] This is at best a tricky course to navigate politically and diplomatically as a third-party stakeholder, and is increasingly more difficult to manage the deeper our requirement for petroleum becomes.

Our national interests have focused our actions, and most of those actions have been directly related to petroleum access. This approach is becoming exceedingly difficult to tolerate on the political palette. In 1990 when Saddam Hussein invaded Kuwait, we had a committed military coalition of 37 partner nations, whereas when the US conducted Operation Iraqi Freedom in 2003 we had a coalition of the willing

140 Klare, Michael T.; Blood and Oil: The dangers and consequences o f America's growing petroleum dependency; Metropolitan Books; page 109; 2004.

141 Klare, Michael T.; Blood and Oil: The dangers and consequences of America's growing petroleum dependency; Metropolitan Books; page 109; 2004.

142 Available from http://www.whitehouse.gov/energy/; Internet; accessed February 20, 2006.

143 Klare, Michael T.; Blood and Oil: The dangers and consequences of America's growing petroleum dependency; Metropolitan Books; page 126; 2004.

primarily consisting of the United Kingdom, Australia and the United States.[144] Further, the deployment of American combat forces around the globe is going to place an enormous drain on our economic, military, and political resources. The cost of keeping troops in Iraq and the Gulf, the Caspian basin, and Colombia, along with their supporting elements at home will easily exceed $150 billion per year.[145] Our military proficiency is not in question, but we certainly cannot continue our current tempo without substantially greater political support.

When considering oil politics we can't deal with the issue only from our perspective. As stated previously, the petroleum producers have more to say in the matter. Venezuela's president, Hugo Chavez has recently stepped up the rhetoric regarding US oil imports from that country. He has reportedly taken steps to obtain contingency buyers of the oil if he and his country decide to cut their exports to the United States.[146] This is simply one example of how the political climate is so directly tied to oil imports, our economy, and ultimately our way of life, and how quickly major shifts can occur.

In the context of politics, Klare supports autonomy versus independence.[147] Independence suggests a cold turkey habit drop, which isn't possible because of the huge infrastructure and political influences revolving around petroleum. Autonomy is a

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144 The military coalition consisted of: Afghanistan, Argentina, Australia, Bahrain, Bangladesh, Belgium, Canada, Czechoslovakia, Denmark, Egypt, France, Germany, Greece, Hungary, Honduras, Italy, Kuwait, Morocco, The Netherlands, New Zealand, Niger, Norway, Oman, Pakistan, Poland, Portugal, Qatar, Saudi Arabia, Senegal, South Korea, Spain, Syria Turkey, The United Arab Emirates, The United Kingdom, and the United States with several more contributing in other means available from http://www.cryan.com/war/; Internet; accessed December 17, 2005.

145 Klare, Michael T.; Blood and Oil: The dangers and consequences of America's growing petroleum dependency; Metropolitan Books; page 182; 2004.

146 Available from http://www.cnn.com/2006/WORLD/americas/02/18/chavez.oil.ap/index.html ; Internet; accessed February 16, 2006. Chavez threatens to cut off oil to U.S. Saturday, February 18, 2006; Posted: 4:59 a.m. EST (09:59 GMT).

147 Klare, Michael T.; Blood and Oil: The dangers and consequences of America's growing petroleum dependency; Metropolitan Books; page 186; 2004.

strategy allowing for the purchase of oil with no strings attached, specifically a guarantee of security, from the provider. This paper does not propose a cold turkey approach to petroleum independence, but rather a transition that builds up our existing partners' security capabilities. It is untenable politically if we abandon our commitments, treaties, and alliances. However we can ensure our partner nations have the capability and capacity to conduct their own security of their own resources and then ultimately we can sever our legacy petroleum security relationships.

National Security

Our National Security Strategy (NSS) outlines the strategic plan for the nation. It shapes foreign policy, relationships with the international community, and the American way of life.[148] It is very easy to draw a thread directly to the NSS in every activity (not just petroleum) whether it is economic, military, or humanitarian operations.

Figures 5 and 6 graphically depict the main points of the 2006 NSS with the specified tasks supported by the pillars of freedom and democracy. Significantly different from previous strategies, the 2006 strategy specifically addresses our oil addiction through igniting a new era of global economic growth by opening and diversifying energy markets to ensure energy independence.

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148 The National Security Strategy of the United States. September 2006. Available from http://www.whitehouse.gov/nsc/nss.html; Internet; accessed January 4, 2006.

Figure 5, Economic Growth Subsets

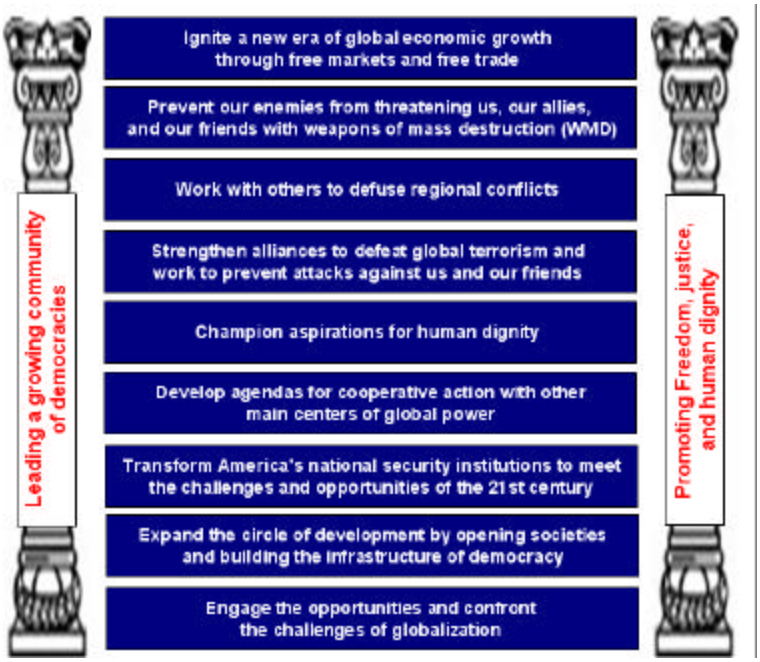

Figure 6, National Security Strategy of United States, 2006[149]

Although the strategy has not been captured in words until recent years, the general strategy effectively hasn't changed for many years. This strategy has resulted in the US pursuing and enforcing economic freedom. This has been accomplished by protecting our interests abroad, including our vital interest in petroleum. More specifically, the petroleum access abroad has been protected by our military or by direct

approach through deploying forces to regions of the world requiring security. Klare makes a convincing case that, despite the outrageous cost in blood and in money, failure in our strategy with respect to our vital interest in petroleum is inevitable.[150] Transformation of energy markets has provoked a debate about whether market forces or geopolitics are more important in determining energy futures, and about what policy approaches are the most useful for ensuring energy security.[151]

A divestiture away from petroleum-based energy simply will provide additional or new options in our national security strategy. It isn't difficult to argue that our national security strategy and petroleum dependence are nearly one in the same. Because the vital interests of the United States are so focused on petroleum access, reserves, infrastructure and security, any lessening or severing of this dependence will allow for a new focus for the national security strategy. This focus may result in the opportunity to engage in new geographic areas of interest, new political interests, or protecting human kind on a grander scale. That is not to say that having zero dependence on petroleum will exclusively make a better world, it will simply change the world in which we live in. The power will transfer from the existing countries that control the oil resources to those who control the new energy sources and its associated infrastructure. If the US can be the lead of the new energy sources and the means in which the power is transmitted, it can gain even more international power and economic supremacy.

Resistance

149 Figure accomplished by the author from the text of the National Security Strategy of the United States.

150 Huebner, Albert; Deadly Dependence: Why US petroleum policy is really about global domination; Toward Freedom magazine; Fall 2004

151 Harris, Martha; Energy and Security; Grave New World. Security Challenges in the 21st Century; Michael E. Brown: Editor; Georgetown University Press; page 157; 2003.

It is no surprise that the oil industry is enormous. In 3 months in 2005, the top 5 oil companies posted profits of $30B, larger than the economies of many of the world's nations.[152] In 2005, British Petroleum has announced annual revenues of $230B, [153] and is exceeded by ExxonMobil, the world's most profitable oil company, who had profits exceeding Greece's GDP. [154] It's no coincidence that four of the richest nations on earth also have the greatest per capita energy usage.[155] Also, in 1998 twenty-four corporations reported US profits before taxes in 1998 of $12.0 billion, yet received tax rebates totaling $1.3 billion.[156] The list of big-name companies getting tax rebates in 1998 included, among others, Texaco, Chevron, CSX, Enron, and Phillips Petroleum. [157] Between the years of 1996 to 1998 the entire petroleum and pipeline industry reported $32.9 billion in profits, $ 4.05 billion in taxes, with $7.4 billion in rebates.[158] Conspicuously these are energy (specifically petroleum) firms that are receiving large rebates from the US tax code. Because of the vast amounts of money involved, this industry won't go away quietly or change without a fight. After all, the oil companies helped eliminate the nation's system of electric trolleys in order to increase the market for gasoline.[159]

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152 Syriana; Movie Reel; A&E Network; 1 hour; Television; Aired Saturday, December 10, 2005 at 5:00 pm.

153 Discovery Times Channel; The color of oil: power profits, and the environmental movement; 1 hour; Television; Aired Wednesday , January 4, 2006 at 10:00 am.

154 Discovery Times Channel; The color of oil: power profits, and the environmental movement; 1 hour; Television; Aired Wednesday, January 4, 2006 at 10:00 am.

155 US, Japan, Germany, and South Korea are the richest nations in th e world. Roberts, Paul; The End of Oil: On the Edge of a perilous new world; Houghton Mifflin Company; Boston and New York; page 150; 2004.

156 Available from http://www.ctj.org/itep/corp00pr.htm; Internet; accessed March 13, 2006.

157 Available from http://www.ctj.org/itep/corp00pr.htm; Internet; accessed March 13, 2006.

158 Available from http://www.ctj.org/itep/corp00pr.htm; Internet; accessed March 13, 2006.

159 Roberts, Paul; The End of Oil: On the Edge of a perilous new world; Houghton Mifflin Company; Boston and New York; page 78; 2004.

Because of power and profit, it is not unimaginable that petroleum stakeholders will take drastic measures to maintain control of their interests.

Also, we cannot forget the oil lobbyists who are equally powerful in the energy industry and in world politics.[160] When it comes to campaign contributions, the Republican Party's ties to the oil and gas industry have been well documented. No longer is it a surprise to note that 78 cents out of every dollar the industry has contributed to federal parties and candidates over the last decade has gone to the GOP, or that President Bush was the No. 1 recipient of the industry's money during the last election.[161]

In any business it would be foolish to move away from ventures that still have profit potential. This is also the case with petroleum coupled with the fact there is huge capital investment in the industry and infrastructure. Until all of the profit sources are depleted, it is not in any industry stakeholder's best interest to scuttle their investment. For this simple reason, the oil industry will be initially resistant to petroleum independence until they recognize and identify a more profitable advantage.

This resistance is evident in similar occurrences throughout history. The major phone companies exercised the same fear and resistance when the cellular market took off. Phone companies like AT&T had invested millions in infrastructure and they were fearful of losing their investment. Of course they didn't lose that infrastructure; there was simply a transition away from the exclusive physical wired infrastructure to the diversity of wireless and wired infrastructures, proving that these fears were unfounded from the beginning.

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160 Discovery Times Channel; The color of oil: power profits, and the environmental movement; 1 hour; Television; Aired Wednesday, January 4, 2006 at 10:00 am.

This resistance within the industry isn't just based on a healthy skepticism. There are real historical examples of how minor shifts in the market that were thought to yield a profit, resulted in financial disaster. Such an example was in Dhabol, India in the early 1990s when Enron Corporation fronted more than 2 billion dollars to build a mammoth gas-fired power plant.[162] Despite the promise of profits from 10 million Indians living without power, Enron underestimated their consumer's ability to pay. Most consumers pirated the electricity and those legitimately connected to the grid simply didn't pay their bills, which was further exacerbated by the Indian government's toleration of the problem through zero enforcement.

The resistance will also manifest itself through the US government. The National Energy Policy Development Group (NEGPDG) was the opportunity for a fork in the road, but government has proven just as fallible as business regarding a shift towards petroleum independence.[163] Vice President Dick Cheney, who coincidentally was the former Halliburton CEO, led the group that was also populated with numerous other energy executives.[164] Having the collective expertise of the panel was essential, but also resulted in an expected conclusion that would not actively pursue an alternate fuels approach or a lower dependency on foreign oil imports. As expected, in April 30, 2001 the report was released sighting an increase in oil, coal, and natural gas production would be the ONLY option to maintain large energy requirements. Further, conservation was

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161 Noble, Larry and Weiss, Steve; A Money in Politics Backgrounder on the Energy Industry; May 16, 2001 available from http://www.opensecrets.org/pressreleases/energybriefing.htm; Internet; accessed on December 2, 2005.

162 Roberts, Paul; The End of Oil: On the Edge of a perilous new world; Houghton Mifflin Company; Boston and New York; page 240; 2004.

163 Klare, Michael T.; Blood and Oil: The dangers and consequences of America's growing petroleum dependency; Metropolitan Books; page 58; 2004.

164 Halliburton is a major oil field services firm

belittled to a personal virtue, rather than an effective course of action. This example is evidence that the highest levels of government will be equally resistant to a shift away from petroleum.

Another point of friction will come from the government taxation of gasoline. Recently, there have been discussions in the US government to tax automobiles based on mileage vice actual fuel consumption.[165] This is because as hybrid cars become more efficient, it is assumed that they will still use equal amounts of highway and its associated infrastructure, all of which is maintained and improved by the gas tax revenue. In 2003, this tax generated over $32 million in state revenue, an amount state and federal governments will be reluctant to forego.[166]

Those countries that have the lion's share of the source of petroleum (e.g. Saudi Arabia) will resist also. Although not without cost and effort, they can reinvent their investments and petroleum sources into new markets. These new markets may be to provide energy to the third world or new products derived from petroleum (e.g. plastics). As with most circumstances, the stakeholders are resistant to change and will be happy collecting their profits from existing petroleum markets so long as they show growth potential.. For all of these reasons it has been difficult to divest from petroleum in the past and some of those challenges will still be present in the near and distant future. However, this paper suggests that it can be both profitable and practical to divest from

165 Debate on the subject available from http://www.cbsnews.com/stories/2005/02/14/eveningnews/main674120.shtml and http://www.artba.org/economics_research/reports/gas_tax_history.htm and http://www.sfgate.com/cgi-bin/article.cgi?file=/c/a/2005/04/20/MNGA4CBJH81.DTL and http://www.boston.com/news/nation/articles/2005/11/26/report_suggests_taxing_hybrid_cars/ ; Internet; accessed February 8, 2006.

166 $32,180,995 for 2003 and $31,968,036 in 2002. US Census Bureau, Census of Governments, State Government Tax Collections Summary Tables, available from http://www.census.gov/govs/www/statetax.html ; Internet; March 2005 data accessed Januar y 7, 2006.

petroleum-based energy.

Recommendations and Strategy

"If you recognize the fact that you're dependent upon oil as being a problem for being the long term, then why don't we figure out a way to drive our cars using a different kind of fuel."[167]

- *President George W. Bush*

Overview

The new Advanced Energy Initiative is really nothing new.[168] Both George W. Bush and John Kerry promised voters that they would make America "energy independent" in their campaigns for presidency.[169] During Bush's campaign for presidency, he pledged to commit $2 billion over 10 years to advance clean coal technology.[170] Later as the president in office, Bush had a plan and incentives similar to today's energy initiative, all received with reluctance and at best marginal success.[171] This presidential futility on energy independence has been documented in every President's administration as far back as Nixon's.[172] There is however a difference when the President of the free world says it's a problem on a stage with an international audience. During Bush's 2006 State of the Union address he was able to capture the attention of the world that the previous administrations were not able to exploit. The bottom line is that we simply cannot continue the costly pursuit of petroleum dependence.

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167 Speech at the Grand Old Oprey in Nashville, TN on February 1, 2006 on his speech circuit to promote his 2006 State of the Union message.

168 Available from http://www.whitehouse.gov/news/releases/2006/01/20060131-6.html; Internet; accessed on February 15, 2006.

169 Available from http://www.factcheck.org/article288.html ; Internet; accessed on February 15, 2006.

170 Available from http://www.fossil.energy.gov/programs/powersystems/cleancoal/ ; Internet; accessed on February 15, 2006.

171 Available from http://www.whitehouse.gov/news/releases/2005/04/20050427-9.html; Internet; accessed on February 15, 2006.

Politically, the new Advanced Energy Initiative sends a powerful message to the rest of the players in the global energy market.[173] The US could divest from foreign oil, but that really is a short-term step in a larger solution to a long-term problem. A real plan would directly include energy markets (both existing infrastructure and new means to transmit energy through the world), obtain savings and/or profits through conservation and efficiency incentives, and the pursuit of inexhaustible/renewable energy sources. Figure 7 is a graphical representation of a new strategy incorporates our existing efforts and introduces new approaches. Regardless of the components of the strategy, a combined focus of advantage gain (profit) and leadership exercised by its stakeholders must be skillfully fused to truly divest from petroleum. Without this critical aspect, the strategy will be without direction and will fail to meet interim objectives and the ultimate goal of petroleum independence.

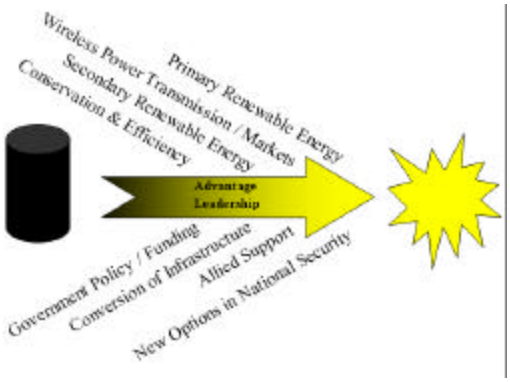

Figure 7, Concept for divestiture from petroleum-based energy[174]

This plan includes a fusion of excellent ideas already proposed by the Apollo Alliance,[175] various energy independence proponents,[176] petroleum independence activist

172 Available from http://www.reason.com/rb/rb072104.shtml; Internet; accessed on February 15, 2006.

173 Available from http://www.whitehouse.gov/news/releases/2006/01/20060131-6.html; Internet; accessed on February 15, 2006.

Armory Lovins,[177] the Advanced Energy Initiative,[178] the Democrat's energy solution,[179] and some newly introduced ideas yet to be included in any energy strategy to date. All of the previous and existing plans regarding energy policy were compartmentalized. They placed the highest importance on finding the "magic" or quintessential one-for-one replacement for petroleum, rather than finding a modular replacement of energy and more importantly the method in which the energy is distributed. This plan allows for the continued use of our existing energy sources but focuses on the long-term solution and ultimately provides a strategy to relinquish our grip on petroleum dependence.

Renewable Energy (Secondary)

It seems that most proponents of petroleum independence focus on the short-term energy sources, probably because they're more attainable in the near term. These energy sources are part of the solution, but not the end state. This also appears to be the focus of the Advanced Energy Initiative where it advocates a transition to modern biofuels. Further, the initiative supports the replacement of another 20%, or all foreign imports, of US oil needs and promote existing technologies in solar and wind.[180] We already have a budding market for E85 fuels which is 85% ethanol and 15% petroleum with numerous

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174 Developed by the author

175 Available from http://www.apolloalliance.org/strategy_center/ten_point_plan.cfm; Internet; accessed on February 15, 2006.

176 Available from http://www.americanenergyindependence.com/ ; Internet; accessed on February 15, 2006.

177 Lovins, Amory B.; How America Can Free Itself of Oil—Profitably; FORTUNE Magazine. Copyright 2004 Time Inc; October 4, 2004.

178 Available from http://www.whitehouse.gov/news/releases/2006/01/20060131-6.html; Internet; accessed on February 15, 2006.

179 Available from http://democrats.senate.gov/energy/about.html ; Internet; accessed on February 15, 2006.

180 Lovins, Amory B.; How America Can Free Itself of Oil—Profitably; FORTUNE Magazine. Copyright 2004 Time Inc; October 4, 2004 and Lovins, Armory B.; Ending our oil dependence; The Ripon forum; Volume, 39; Number II; page 13; March/April 2005.

vehicles already modified to burn this type of fuel.[181] These steps are a move in the right direction, but simply represent one rung on the ladder as we climb towards total petroleum independence.

New renewable energy (Primary and Secondary)

Primary sources of energy are critical to the success of this strategy. Defense Advanced Research Projects Agency (DARPA), industry, and other government agencies are already pursuing harvesting energy from the environment.[182] These energy sources will free the world from its futile dependence on petroleum-based energy and even other secondary energy sources. These technological solutions will prove significant forcing functions to achieve petroleum independence.

Earth and Atmosphere

The earth and the atmosphere could be categorized as a primary energy source. Imagine pulling energy directly out of thin air. There is no doubt that the atmosphere is a repository for substantial quantities of electrical energy. A lightning strike has a peak power of about one million megawatts (MW), or an average over the duration of the strike of about 500,000 MW.[183] The idea of harnessing electrical energy from the atmosphere has promise but it must be noted that a lightning strike lasts an average of only about 30 microseconds. To power the United States by lightning, it would be

181 Available from http://www.e85fuel.com/e85101/flexfuelvehicles.php; Internet; accessed on February 7, 2006.

182 Available from http://www.darpa.mil/ ; Internet; accessed on February 15, 2006.

necessary to harvest the energy of 33,000 lightning strikes per second, or about 3 billion per day, or the equivalent of 322 per square kilometer per day.[184]

It is seldom realized that the earth itself may be a source of energy. The earth is actually charged at millions of volts but most don't realize this because virtually everything on the earth is also charged to the same potential.[185] A circumstance can be produced that creates a voltage differential to tap into the earth's energy; similar to a static discharge observed while walking across a carpeted room and touching a doorknob. Further, many meteorological phenomena are electrically driven. We've always thought of lightning as electrical, and now we're beginning to realize that we can think of tornadoes and hurricanes as electrical phenomena, too. Tapping into this energy source could result in an inexhaustible supply of energy that is literally everywhere.

Thermoelectric Devices

Early 19th century scientists, Thomas Seebeck and Jean Peltier, first discovered the phenomenon that is the basis for today's thermoelectric industry. Seebeck found that if you placed a temperature gradient across the junctions of two dissimilar conductors, electrical current will flow. Peltier learned that passing current through two dissimilar electrical conductors caused heat to be either emitted or absorbed at the junction of the

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183 Cloud Power: A letter from Dr. Mohammad Jainul Abedin with an evaluation by NATURAL SCIENCE available fr om http://naturalscience.com/ns/letters/ns_let19.html; Internet; accessed on September 15, 2005.

184 Cloud Power: A letter from Dr. Mohammad Jainul Abedin with an evaluation by natural SCIEN CE available from http://naturalscience.com/ns/letters/ns_let19.html; Internet; accessed on September 15, 2005.

185 The Electric Earth; available from http://www.thunderbolts.info/tpod/2005/arch05/051012electric-earth.htm; Internet; accessed on December 13, 2005.

materials, commonly known as the thermo-electric effect.[186] By employing thermoelectric power generators we can convert heat energy to electricity. When a temperature gradient is created across the thermoelectric device, a DC voltage develops across the terminals. When a load is properly connected, electrical current flows. Typical applications for this technology include providing power for remote telecommunication, navigation, re-generation, and remote petroleum pumping facilities. We can utilize the temperature differential observed throughout the earth to create fuel cells via the thermo electric effect. An extreme example of this differential could be using carbon nanofibers to make a cable from the earth to outer space. This cable could capitalize on the cold temperatures of space relative to the warm earth's crust to create the voltage differential and electrical generation.

Helium 3

Helium 3 mixed with heavy water is an identified fuel source for a cleaner, more powerful fusion reaction.[187] Helium 3 is located on earth, but it has been identified that most of the fuel source is available on the moon. It is estimated that a total of 1,100,000 metric tons of Helium 3 have been deposited by the solar wind on the moon.[188] About 25 tons of Helium 3 would power the United States for 1 year at our current rate of energy

186 An Introduction to Thermoelectrics available from http://www.tellurex.com/cthermo.html; Internet; accessed on February 2, 2006.
187 About 10 times the energy we could get from mining all the fossil fuels on Earth, without the smog and acid rain. Available from http://www.asi.org/adb/02/09/he3-intro.html ; Internet; accessed February 1, 2006.
188 Kulcinksi, Cameron, Santarius, Sviatoslavsky, and Wittenberg, "Fusion Energy from the Moon for the 21st Century." 1988. Fusion Technology Institute, University of Wisconsin.

consumption.[189] Although this is not a renewable energy source, it appears to be one with more energy density than petroleum.

Conservation and Efficiency

This paper has already highlighted successful conservation areas, and has discussed how some sectors have conserved energy successfully, efficiently, and profitably. This section however is focused on how it is important to execute the best practices in order to achieve petroleum independence. By attacking the huge reservoir of waste we have in this country we could double our oil use efficiency. The US today wrings twice as much work from each barrel of oil as it did in 1975.[190] If we coordinate public policies and business strategies to speed the adoption not just of super-efficient light vehicles, heavy trucks, and airplanes. Further we can use established, highly profitable efficiency techniques to save half the projected 2025 use of natural gas resulting in profitable efficiencies.[191] Our household appliances are just as guilty at wasteful consumption of energy and grand efficiencies can be gained here as well. Further, innovative use of the tax code and economic development systems like feebates can stimulate conservation for the sake of profit.

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189 To put it in perspective: that's about the weight of a fully loaded railroad box-car, or a maximum Space Shuttle payload. Available from http://www.asi.org/adb/02/09/he3-intro.html ; Internet; accessed February 1, 2006.

190 Lovins, Amory B.; How America Can Free Itself of Oil—Profitably; FORTUNE Magazine. Copyright 2004 Time Inc; October 4, 2004.

191 Lovins, Amory B.; How America Can Free Itself of Oil—Profitably; FORTUNE Magazine. Copyright 2004 Time Inc; October 4, 2004.

Conversion of infrastructure

The conversion of our existing petroleum-based infrastructure must occur for the plan to be successful. With a true plan to divest from petroleum, we can now see how the industries and infrastructure should be re-configured to support that end. The most significant reconfiguration advantage will come from the transportation industry, first with the automobile designs, then with infrastructure sustaining those automobiles. By reconfiguring[192] our existing automobiles to omni hybrids or hyper cars we can burn any fuel source, not just petroleum.[193] If industry purposely designs this into the transportation industry, as better sources of power for electrical generation are developed (e.g. bio diesel vs. petroleum diesel or a wireless power receiver) they can be easily implemented into future designs.

This conversion actually makes it more profitable for the industry. By simply providing multiple fuel sources, it will make people more likely to purchase the technology. It further provides redundancy, robustness, and diversity in the energy market similar to dispersed/distributed power. In the case of the military it will allow for a transformational quantum leap in military mobility, agility, and logistics.

Enablers

All of these emerging renewable technologies and proposals to changes in infrastructure will need support from some enabling technologies. Such an enabler is the

192 An expanded so lution for re-configuration automobile design is provided in Appendix A

graphite nanofiber discovered by Terry Baker and Nelly Rodriguez at Northeastern University.[194] They are solid bricks of fuel that have the property to act very much like a sponge and can soak up hydrogen in high density with a small volume. They have been able to grow this material from small metal particles interacting with hydrocarbons. They have the ability to manipulate the metal particles to create honeycomb structures ideally suited for the storage of hydrogen. As a means of comparison, a 1-liter container of pressurized hydrogen will drive a car 1 mile whereas a graphite nanofiber fuel source of the same volume can drive the same car 25 miles. With the current average gasoline tank at 50 liters, the same amount of graphite nanofiber can propel an automobile 1250 miles on a single fueling.

Nanolife (1000 times smaller than the smallest fish) may provide the catalyst to making hydrogen and other secondary renewable energy sources approach primary renewable energy sources. By obtaining the genetic code of microorganisms we can artificially reproduce them so that they can manufacture hydrogen.[195] Researchers have already discovered 20,000 new proteins that metabolize waste and produce hydrogen as a byproduct.[196] A direct example of one the new proteins is Chlamydomonas reinhardtii, a green algae (pond scum), dark, oxygen deprived environment, enzyme that generates a

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193 Hyper cars is a term used by some in the industry that capitalize on hybrid technology but primarily lower the weight of the vehicle to improve fuel efficiency. Assignment Discovery; The properties and uses of aluminum, indium, tin, lead and other metals; Discovery Channel; 1 hour; Television; Aired Thursday December 15, 2005 at 5:00 am.

194 Assignment Discovery; The properties and uses of aluminum, indium, tin, lead and other metals; Discovery Channel; 1 hour; Television; Aired Thursday December 15, 2005 at 5:00 am.

195 Sorcerer is an unorthodox vessel gaining samples of multiple ocean organisms. Venter, J. Craig; Cracking the Ocean Code; The Science Channel; 1 hour; Television; Aired Fr iday, December 9, 2005 at 3:00pm

196 Venter, J. Craig; Cracking the Ocean Code; The Science Channel; 1 hour; Television; Aired Friday, December 9, 2005 at 3:00pm

small ratio of energy and in the process releases trace amounts of hydrogen.[197] Further, findings suggest that a trillion new microbes process sunlight and CO_2 to create O_2-- about 10-20% of the earth's chemistry.[198] Each year plant life on earth captures and stores 7 times more energy than what is released in the burning of fossil fuels in one year, and ocean life captures even more than that.[199] This area has so much potential the US Department of Energy has allocated $14 million to find similar hydrogen-producing proteins.[200]

These possible alternative renewable energy sources and subsequent enablers could lower demand or replace altogether our petroleum requirements. Until now we have attempted to acquire these sources independent of a coherent strategy and simply hoped that they would revolutionize our energy market. This paper offers an evolutionary modular approach of how and when each one is proven economically profitable, technically feasible, and competitive with existing energy sources, it can be incorporated into our future energy infrastructure.

Wireless power transmission and markets

If we modernize our electrical infrastructure to wireless power transmission, it will result in the most significant advancement towards total petroleum independence. Once this technology is mastered and the infrastructure to support it is in place, then we

197 Roberts, Paul; The End of Oil: On the Edge of a perilous new world; Houghton Mifflin Company; Boston and New York; page 188; 2004.

198 Roberts, Paul; The End of Oil: On the Edge of a perilous new world; Houghton Mifflin Company; Boston and New York; page 188; 2004.

199 Roberts, Paul; The End of Oil: On the Edge of a perilous new world; Houghton Mifflin Company; Boston and New York; page 188; 2004.

can connect renewable energy sources that are domestically secure to the system and gain even greater independence all while achieving economic growth.

The key to economic growth and petroleum independence is to develop industrial wireless power transmission technology. Of the 6.5 billion people in the world there are still 2 billion people who live without electrical power.[201 and 202] The major restriction or limitation to this market is delivering the power to the customer because of a lack of infrastructure. To date, we simply have not developed the means to provide electric service to remote areas of the world in a cost effective manner. However, this limitation could be removed through wireless power distribution. This should be inviting to the energy industry not only because they could open the market to 2 billion new customers but they could also be competitive energy suppliers to the existing 4.5 billion customers that already have power.[203] The market that would emerge from wireless transmission of energy would also be realized in the transportation industry. In some states the number of cars on the road is growing 50% faster than the population.[204] Imagine if we could power our vehicles through wireless technology, and the profits associated with such a vision are unlimited.

The modern energy delivery infrastructure consists of vast pipelines, oil derricks and high voltage transmission power-lines. A transformation from a network of physically connected petroleum-based infrastructure is analogous to land line

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200 Roberts, Paul; The End of Oil: On the Edge of a perilous new world; Houghton Mifflin Company; Boston and New York; page 188; 2004.

201 World population statistics available from: http://www.census.gov/ipc/www/world.html; Internet; accessed February 2, 2005.

202 Estimates provided by Understanding Electricity; The Science Channel; 1 hour; Television; Aired Jan 11, 2006 at 8:00 am.

203 Breaking into foreign energy markets was previously an impossibility due to access and lack of infrastructure

204 Understanding; Car Travel becomes increasingly hazardous; The Science Channel; 1 hour; Aired, Friday February 3, 2006 at 5:00pm.

communications (e.g. telephone) and cellular based communications. The same phenomenon that occurred in a saturated telecommunications market when the cellular phone emerged will have the same effect that wireless power transmission would have on the energy industry.

Before you dismiss this proposal as science fiction or a pipe dream, Nicola Tesla already accomplished this over 100 years ago.[205] Tesla is credited for having invented the radio, the electric generator, and determined that electricity could be transmitted more efficiently using alternating current at very high voltages.[206] He is also directly responsible for our modern way of electric life.[207] After all, we see nature accomplish this fantastic feat by the sun transmitting massive amounts of energy over millions of miles to the earth each day.

In 1900, Tesla applied for and was granted a US patent for wireless power transmission through the atmosphere.[208] The drawing for Tesla's wireless power patent looks similar to the earlier power-by-wire patent except now spherical antennas replace the transmission lines. The Tesla patent also contains a discussion of how rarefied gases in the upper atmosphere became quite conductive when thousands of volts are applied, which is similar to the same way we transmit power through physical power lines today.

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205 Nicola Tesla is credited as the brain -child of our modern electrical infrastructure. Germano, Frank; Tesla's Magnifying Transmitter: The history surrounding this amazing device!; available from http://mysite.verizon.net/vzeoyr81/magtrans.html ; Internet; accessed on October 15, 2005.

206 Germano, Frank; Tesla's Magnifying Transmitter: The history surrounding this amazing device!; available from http://mysite.verizon.net/vzeoyr81/magtrans.html; Internet; accessed on October 15, 2005.

207 Germano, Frank; Tesla's Magnifying Transmitter: The history surrounding this amazing device!; available from http://mysite.verizon.net/vzeoyr81/magtrans.html; Internet; accessed on October 15, 2005.

208 US patents 645,576 System of Transmission of Electrical Energy applied for on Sept. 2, 1897 and 649,621 Apparatus for Transmission of Electrical Energy applied for in Sept . 2, 1897, were the beginnings of his pursuit for wireless power transmission. Available from http://www.tfcbooks.com/patents/patents.htm; Internet; accessed September 11, 2005.

Tesla's wireless power would be the ultimate centralized electric system, a capitalists' dream. Because the principles for wireless power transmission are nearly identical to wireless communication, the same encryption and security protocols could be used to ensure power transmitted are safeguarded against pirated access, similar to cable TV or analog cell phones.[209]

Tesla documented his theories and he executed his proof of concept with his Magnifying Transmitter in Colorado Springs, Colorado and then later with marginal success with his Tesla Tower in Wardenclyffe, New York.[210] Tesla reasoned the earth's resonant frequency was the ideal frequency for wireless power transmission, and he tuned his ultimate magnifying transmitter accordingly. In one memorable experiment he wirelessly powered, at a distance of 26 miles from his lab, a bank of incandescent bulbs. This power used to illuminate this bank of lights was equivalent to 10,000 watts.[211]

In a newer Tesla patent, he no longer speaks of energy broadcast through the upper strata of the atmosphere but through the earth itself.[212] Tesla predicted that his magnifying transmitter would prove most important and valuable to future generations and that it would bring about an industrial revolution.[213]

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209 Explanation of how today's cell phones work is available from http://electronics.howstuffworks.com/cell-phone4.htm; Internet; accessed January 5, 2006.

210 Germano, Frank; Tesla's Magnifying Transmitter: The history surrounding this amazing device!; available from http://mysite.verizon.net/vzeoyr81/magtrans.html; Internet; accessed on October 15, 2005.

211 Germano, Frank; Tesla's Magnifying Transmitter: The history surrounding this amazing device!; available from http://mysite.verizon.net/vzeoyr81/magtrans.html; Internet; accessed on October 15, 2005.

212 Tesla's US patent 787,412, Art of Transmitting Electrical Energy through the Natural Mediums was applied for on May 16, 1900 and was granted on April 18, 1905. Available from http://www.tfcbooks.com/patents/patents.htm; Internet; accessed September 2, 2005.

213 Germano, Frank; Tesla's Magnifying Transmitter: The history surrounding this amazing device!; available from http://mysite.verizon.net/vzeoyr81/magtrans.html; Internet; accessed on October 15, 2005.

According to Arthur Mathews, Tesla later demonstrated his wireless transmission of electrical energy in the early 1930s in Canada.[214] The transmitter was assembled in the early spring at a large camp in the woods near Lac Edouard, about 10 miles from Sanford, Quebec. Power was then sent to a transformer ten miles away and the power sent was reported to be considerable.

We have seen remarkable efficiencies in the business sector with innovations like just in time inventory. Imagine achieving the same effects with just in time energy? As with supply inventories, we will no longer have to maintain large distribution warehouses analogous to our fuel farms and fueling stations.

One can only speculate why industrial wireless power transmission hasn't been accomplished since the 100+ years that the proof of concept was observed. The following are some plausible reasons that this technology has not been exploited to date:

1) It could not be regulated and/or metered--until now. This can be more easily categorized as the resistance resultant from the industry. If the energy cannot be sold, it would upset the existing energy markets of the 1900s and thereafter. Tesla's patents simply demonstrate the possible technology. The technology described in the patents does not advance to the next step to exclude, restrict, monitor, regulate, and/or meter wireless power use. JP Morgan personified this resistance when he was quoted after observing the proof of concept by saying, "Where do I put the meter?" The same quandary was originally observed with cellular phones. However, cellular phones now have an efficient means of

214 Tesla frequently asked questions available from http://www.tfcbooks.com/teslafaq/q&a_051.htm; Internet; accessed on December

determining individual customers, metering their usage, and charging for service. The same can now be accomplished with wireless power, whereas it was not technologically feasible before.[215] For this reason, the time is ripe for the paradigm shift away from a wired infrastructure. As with the telecommunications industry, we have not weaned ourselves entirely away from wired communication. We still have landlines for telephones, fiber optic cable for high-speed data, and get most of our television signals to the end user via coaxial cable. All of this occurs in a market where the same signal can be delivered to end users via satellites and/or microwave wireless communications at comparable capacity and speed. Industries that are resistant to the shift to wireless because of the fear of losing investment in the wired infrastructure should acknowledge it will not happen overnight. Further, it will not result in an immediate scuttling of the current infrastructure. As with most emerging markets, if the stakeholders participate early, they can profit from, and even shape the future of wireless energy. Thailand and the Philippines serve as modern examples to negate this fear because they are regions with minimal landline infrastructure, which resulted in populations without modern communications. However, with the advent of cell phone the technology was able to leapfrog past landline infrastructure and it subsequently boomed and continues to grow.[216] The industry also figured out

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15, 2005.

215 When cell phones first came out on the market their signal too was transmitted "freely" into the atmosphere for anybody to bootleg their signal. Now there are Electronic Identification Numbers (EIN) that delineate each phone and provide a means of security and metering for the individual phone.

216 Available from http://news.com.com/Worldwide+cell+phone+sales+climb/2100-1039_3-5070434.html ; Internet; accessed January 4, 2006.

unique and innovative ways to charge for the service making it economically feasible.[217]

2) There could have been insurmountable technological hurdles. Remember, the proof of concept was observed in early 1900. However, we have had huge successes with microchips and other technologies that were not available during that time. These leaps in technology may have been insurmountable in the 1900s, but could very well be commonplace in 2006.

3) It could have been sequestered under patent secrecy due to national security.[218] For example, nuclear fusion research began in 1951 in the United States under military auspices, yet we dropped the first atomic bomb in 1945.[219] After its declassification in 1957, scientists began looking for a candidate fuel source that would not produce neutrons.[220] It is possible that we have the same circumstance related to the patent secrecy issues with wireless power. Oil is still one of the cheapest, most easily transportable energy sources we have yet to find. There is no advantage to tipping the hand of new technology before it is forced to do so. After all, large amounts of capital have been invested in oil recovery, refinery, infrastructure, transportation, and use. Ultimately, it would be foolish to abandon future potential profits. Although, because the patents for Tesla's wireless power

217 Pre-paid cards to load minutes of service are extremely popular and nearly exclusively utilized in poorer nations to ensure payment for service.

218 Executive branch agencies generated 14 million new secrets in 2003, a 25 percent increase from th e preceding year, and a 60 percent increase from the year before that. Obtained from the 2003 Annual Report to the President, Information Security Oversight Office, available from www.archives.gov/isoo/reports/2003_annual_report.html ; Internet; accessed January 17, 2006.

219 Available from http://www.dannen.com/decision/ ; Internet; accessed January 19, 2006.

220 Available from http://www.space.com/scienceastronomy/helium3_000630.html ; Internet; January 3, 2006.

transmission are accessible via the Internet, this explanation has diminished plausibility.

4) As with most innovations, there are potential risks and downfalls. Aside from the financial risk in developing efficient, realistic, and feasible power transmission. It is unknown how transmitting power wireless through the earth's core or atmosphere will affect the tides, weather, and environment as a whole. This may be the quintessential friction point that prevents us from transforming our infrastructure to a wireless one and ultimately cutting our petroleum tether.

Wireless power transmission can transform transportation on a grander scale. Future wireless autos, trains, and aircraft would result in a revolution within the industry. Imagine the advantage achieved in transportation via wireless power transmission. This advantage is realized in cost savings of having to transport bulk fuel and more importantly, having the freedom of movement without a physical tether back to a fuel source. Wireless power transmission is the catalyst that shifts the paradigm away from petroleum-based energy sources all doing so while gaining a profit.

"The only thing that we didn't pack sufficiently for was fuel!"[221]

- Brigadier General John F. Kelly

221 Commenting to JAWS class on January 19, 2006 about the plan for Operation Iraqi Freedom (OIF). He was the assistant Division Commander of the 1st Marine Division, which was one of the US units that sped to Baghdad in the early days of OIF. This statement was in reference to the mandate by CENTCOM Commander's (Gen Franks) requirement for speed in getting to Baghdad. Speed to Baghdad was so much a priority in the operation, they "planned" for the troops to only get 1 MRE each day. Ultimately, the US military forces were parasites off the Iraqi oil system to obtain their fuel because their logistics were p lanned to be light, agile and fast.

Potentially the organization that benefits the most from wireless power transmission is the US Department of Defense. The DoD accounts for 75 percent of the total energy used by the Federal government.[222] Half of the DoD's energy goes to support fixed bases, and half goes to forces on the move.[223]

Today we have some real-world alternative approaches to Tesla's wireless power transmission by using microwave beams to transmit power.[224] There are also prototype developments for wireless power transmission for micro air vehicles.[225] Further, solid state lasers have been recently developed that allow efficient transfer of power in the range of 10% to 20% efficiency.[226] With a concerted effort, these and other technologies could be scaled for immediate use in industrial wireless power transmission.

Regardless of whether we pursue a world wide powerless grid system like that of Tesla's proposals or existing microwave and laser systems, a wireless power grid would transform our energy infrastructure drastically. After wireless power transmission is mastered, it will open the door for alternate, clean-burning energy sources to provide the source of the power transmitted. In the meantime, we can continue to use petroleum-based energy, but use it more efficiently and use it from geo-political regions that limit our vulnerabilities. Nonetheless, a major fear of the stakeholders is that an attempt to

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222 Lynn, Larry; Statement; Director, Defense Advanced Research Projects Agency; Before The Committee on Armed Services Subcommittee on Acquisition and Technology United States Senate; March 12, 1998.

223 Lynn, Larry; Statement; Director, Defense Advanced Research Projects Agency; Before The Committee on Armed Services Subcommittee on Acquisition and Technology United States Senate; March 12, 1998.

224 Soubel, Andrew K.; Solar Power Satellites and Microwave Power Transmission. Energy Law Spring 2004 Chicago-Kent College of Law. US Department of Energy; EREC Brief Solar Power Satellites; available from http://www.eere.energy.gov/consumerinfo/refbriefs/l123.html; Internet; accessed on December 2, 2005 and available from http://sbir.nasa.gov/SBIR/abstracts/04/sbir/phase1/SBIR-04-1-X2.03-9461.html ; Internet; accessed January 12, 2006.

225 Robert L. Vitale. Report number: A272763. JUN 1999 available from http://www.stormingmedia.us/27/2727/A272763.html ; Internet; accessed January 19, 2006.

quit petroleum cold turkey will result in investment losses. This is the very reason that we have seen slow progress towards alternative energies. Wireless power transmission has the potential to eliminate and/or diminish the limitations that petroleum-based energy causes.

Government policy / funding

Governmental leaders should promote feebates towards highly efficient transportation and buildings. This can be accomplished through initiative funding, targeted taxes, further increasing CAFE standards, and/or offer incentives to move the energy industry. For example, President Bush's Advanced Energy Initiative requests $2.1 billion, a 22 percent budget increase, to develop new technologies and alternative sources of energy to help diversify and strengthen our nation's energy mix. Within that funding request, $150 million has been requested for the biofuels portion of the initiative in his fiscal year (FY) 2007 budget, a $59 million (60%) increase from FY 2006.[227] This type of funding by government will pave the way towards energy independence and we should continue to invest in similar initiatives.

Allied support

We can use our pole position in world politics and economics to move the rest of the world along a similar path of independence. If we partner with our allies towards petroleum independence it will create a synergistic effect and will accelerate progress

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226 Space Power; SPS Timeline; available from http://www.spacefuture.com/power/timeline.shtml; Internet; accessed September 10, 2005.

227 Available from http://www.energy.gov/news/3255.htm; Internet, Accessed April 10, 2006.

towards a solution. It is possible that the US will eventually solve this dilemma first, but it is more likely is that countries like Japan, Germany, and the United Kingdom will be even more willing to implement these recommendations on their own. This is evidenced by the fact that they have already implemented government-sponsored conservation efforts and simply because their cost for petroleum (See Table 2) have historically exceeded the United States. For this reason they have a more compelling case to divest from petroleum sooner rather than later and have not been willing to wait for the US to provide a solution.

Nation	Price		Nation	Price
UK	**$5.64**		AUSTRALIA	**$2.63**
HONG KONG	**$5.62**		CAMBODIA	**$2.57**
GERMANY	**$5.29**		TAIWAN	**$2.47**
DENMARK	**$5.08**		GEORGIA	**$2.31**
NORWAY	**$5.07**		LAOS	**$1.66**
ITALY	**$4.86**		THAILAND	**$1.60**
TURKEY	**$4.85**		CHINA	**$1.54**
PORTUGAL	**$4.80**		RUSSIA	**$1.45**
KOREA	**$4.71**		KAZAKHSTAN	**$1.36**
SWITZERLAND	**$4.56**		UNITED STATES	**$1.34**
AUSTRIA	**$4.50**		TAJIKISTAN	**$1.32**
CROATIA	**$4.32**		AZERBAIJAN	**$1.15**
JAPAN	**$3.84**		VENEZUELA	**$0.14**

Table 2 – World Fuel Prices (May 2004)[228]

New National Security Options

228 Available from http://tonto.eia.doe.gov/dnav/pet/hist/rruusgM.htm and http://money.cnn.com/pf/features/lists/global_gasprices/price.html; Internet, accessed March 14, 2006.

Our national security objectives can be refocused in other areas besides petroleum. Just because we abandon petroleum-based energy doesn't mean that we will disengage from those countries that possess petroleum sources. It simply allows for a new approach to accomplish our interests and/or a reshuffling of priorities.

It is precarious to postulate how the global security landscape would be depicted without petroleum. However, there are some historical examples that can be extrapolated to predict how future petroleum dependence will reflect upon global security. One such example is how petroleum revenues propelled Saddam Hussein's regime to violence in the Middle East and fostered his regime's ability to threaten the global stage. Without petroleum as an economic base, it would prevent future incidents of this nature by nations or actors. A divestiture from petroleum-based energy would simply re-shuffle the global power base from volatile regimes like that of Saddam Hussein's.

Because of our historical national interest in energy security, we have not been able to focus on the other essential tasks of National Security Strategy (see Figure 6). A divestiture from petroleum could reallocate funding and allow concentration on the other essential tasks. For example, a larger problem than the threat of weapons of mass destruction or transnational terrorism is that of exploding population growth. The human population is approaching maximum capacity and is still growing geometrically. This population increase will undoubtedly result in future conflicts for natural resources. If we do not address our other essential tasks outlined in our NSS and their associated problems now, we face an uncertain future and a grave new world.

Our most significant driver for this strategy is that we can change our position and ultimately interests regarding energy. When we started with petroleum as our primary

energy source, the United States was clearly the king of the oil derrick. However, as new petroleum sources were discovered elsewhere around the globe, our energy position has eroded over the last half century. By shifting to new energy sources and/or means to globally transmit energy, we can turn our current position of disadvantage to one of advantage. Further, we can export the technologies required for petroleum independence to other countries to stimulate freedom and promote democracies. Lastly, if we do not aggressively pursue energy alternatives, those countries that we're encouraging to become part of the global democratic community simply won't be able to transition to modern society. This is because our current energy sources (e.g. petroleum) are far too expensive for developing nations to purchase to gain an improved status.

Strategy Summary

In summary, Figure 7 represents the transition from petroleum-based energy (represented by a barrel of crude oil) to primary renewable energy (represented by the sun) requires concerted effort and strategy. Through government policy (e.g. increase Corporate Average Fuel Efficient – CAFE standards) and conservation (e.g. hybrid vehicles, lower consumption etc.) we can begin to curb our demand for imported oil. Further, an increased investment in secondary renewable energy (e.g. wind, photovoltaic, geothermal, hydrogen fuel cells etc.) will further decrease our demand, causing the price of oil to decrease, opening up more oil markets--primarily in less developed nations. Later, wireless power transmission technologies (e.g. microwaves) reduce our transportation costs and further lower reliance on oil imports, which can then be magnified by sharing/selling this technology to our allies and partners. Finally, we should pursue a primary renewable energy resource (e.g. sun, earth's magnetic fields

etc.), to further open new markets for wireless power transmission. It is important to emphasize that this strategy is designed to be modular and not linear. This approach is significantly different from other proposals because it deliberately and delicately negotiates the trade-space between the stakeholders like no other offered to date.

Conclusion

So what are we left with? A growing economy, new energy markets, alternative national security objectives, less expensive oil, a better environment, with the majority of petroleum that we do use is easily convertible to other products. Total success can only be achieved by implementing the entire strategy. However, the plan is designed to be modular, thus independent successes will contribute to our incremental petroleum independence.

Lovins' plan for oil independence is similar to this strategy in the areas of conservation, energy alternatives, and government policy. Although Lovin's plan is lacking the wireless power portion of the author's strategy. He estimates the total investment needed to implement his strategy is approximately $180 billion over the next decade.[229] The wireless energy and other portions of the author's strategy increases the estimated price of implementation to around $200 billion. The $200 billion may seem costly, but every time the price of oil goes up $1 a barrel, Americans export billions in access, security, and infrastructure. Interestingly, according to documented congressional appropriations, the cost of the 2003 Iraq war has been in excess of $272B; money that could be used to fund our total petroleum independence.[230] Whereas if it were not for our national interest in oil, the Iraq conflicts may have been avoided altogether, because our

229229 Lovins, Amory B.; How America Can Free Itself of Oil—Profitably; FORTUNE Magazine. Copyright 2004 Time Inc; October 4, 2004.

230 Available from http://nationalpriorities.org/index.php?option=com_wrapper&Itemid=182; Internet; Accessed April 10, 2006.

efforts in the region would be focused differently.[231] In the next 5-10 years early steps in this energy plan could save as much oil as the US imports each year from the Persian Gulf. By 2040, oil imports could be gone entirely, and by 2050 the US economy could declare its energy independence.

A pessimistic perspective regarding petroleum independence has dominated the landscape throughout our recent history. However, the conditions are now right to quit the petroleum habit and continue to enjoy economic growth, increased security, and a better global environment. Despite previous attempts to achieve petroleum independence, the time is right because it is simply becoming too costly to pursue petroleum-based energy. This paper provides a real strategy towards petroleum independence that will propel us well into the future, not just through the next Presidential election.

231 It is not the contention of the author that the conflict(s) in Iraq were solely a function of the grab for oil in the region. There are plenty of other independent reasons for the conflicts (e.g. human dignity, human rights, threatened neighbors etc.). However, oil and the security thereof seems to be the dominate one of the many reasons for the US engagement.

Appendix A – Automobile Conversion

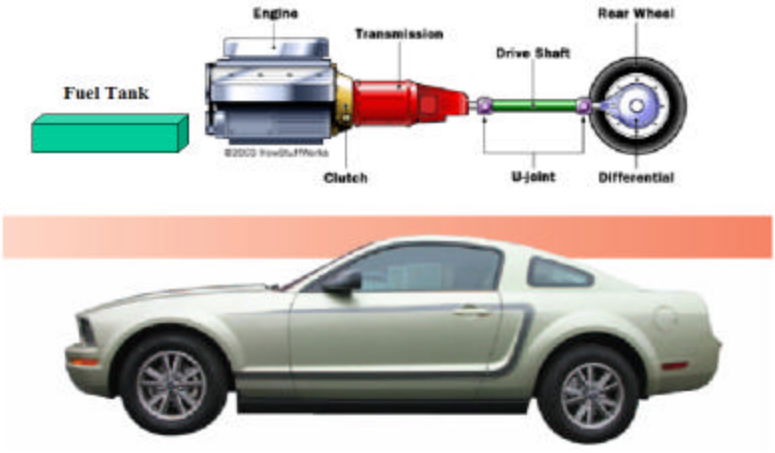

Figure A1, Conventional Automobile Design[232]

Conventional Automobile Design

The design of today's conventional automobile converts petroleum as a fuel source directly into mechanical power to propel the vehicle. The current design is dependent upon the sequential linkage provided from petroleum fuel source to the wheels moving across the ground. If any part of the design is removed, the automobile simply will not operate.

232 Copyright graphic from How Stuff Works with additional descriptors and elements provided Available from http://auto.howstuffworks.com/hybrid-car2.htm; Internet; accessed on February 15, 2006.

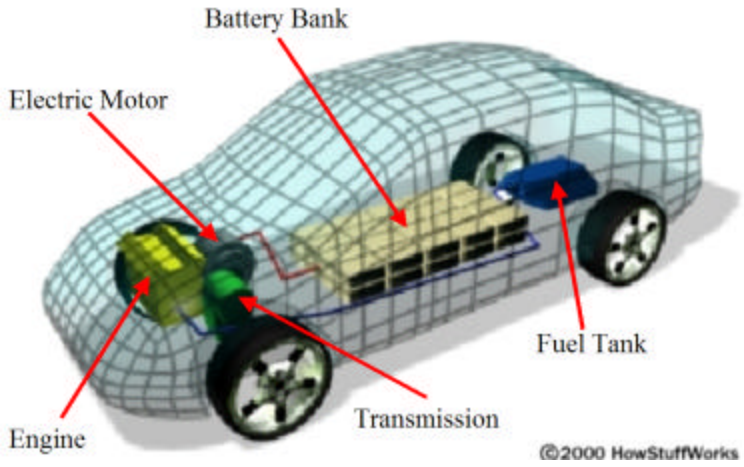

Figure A2, Parallel Hybrid Design[233]

Parallel Hybrid Design[234]

Most hybrids on the market today are categorized as parallel hybrids because they utilize both an internal combustion engine and an electrical motor to propel the vehicle, which are fused together by a transmission. A hybrid car harnesses these two sources of power to increase efficiency and provide the kind of performance demanded by consumers.

233 Copyright graphic from How Stuff Works with additional descriptors provided. Available from http://auto.howstuffworks.com/hybrid-car2.htm; Internet; accessed on February 15, 2006.

234 Available from http://auto.howstuffworks.com/hybrid-car2.htm and http://www.nrel.gov/vehiclesandfuels/hev/hevs.html; Internet; accessed on February 15, 2006.

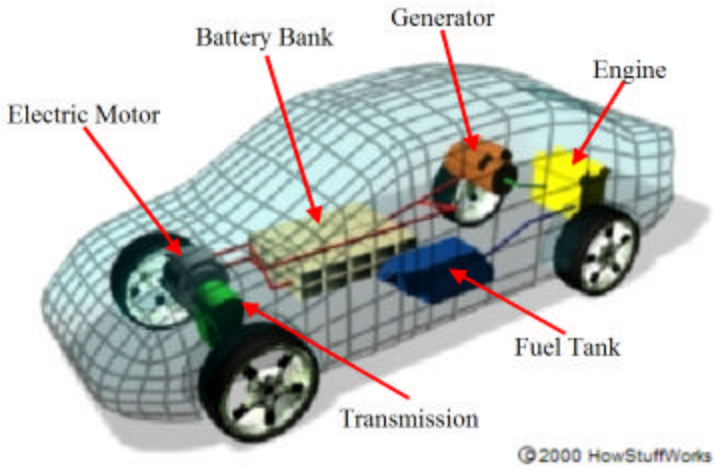

Figure A3, Series Hybrid Design[235]

Series Hybrid Design[236]

By contrast, in a series hybrid the engine turns a generator and the generator can either charge the batteries or power an electric motor that drives the transmission; thus, a petroleum engine never directly powers the vehicle. This is a step in the right direction, but we have yet to complete the full hybrid evolution.

235 Copyright graphic from How Stuff Works with additional descriptors provided. Available from http://auto.howstuffworks.com/hybrid-car2.htm; Internet; accessed on February 15, 2006.

236 Available from http://auto.howstuffworks.com/hybrid-car2.htm and http://www.nrel.gov/vehiclesandfuels/hev/hevs.html; Internet; accessed on February 15, 2006.

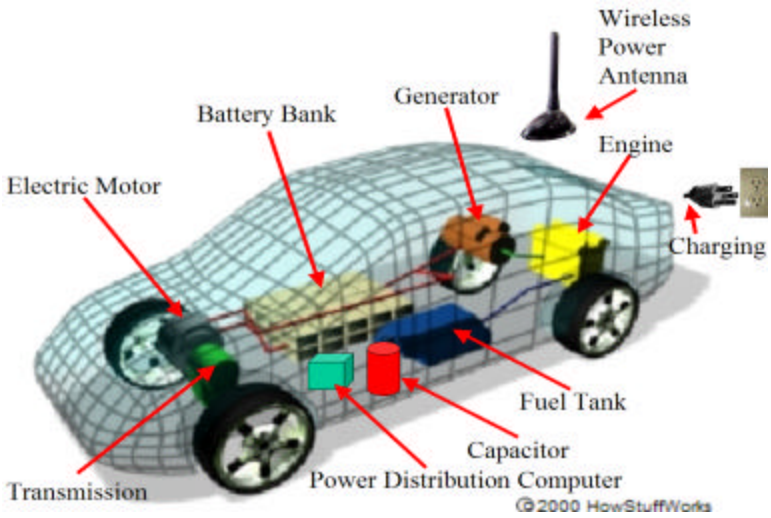

Figure A4, Omni Hybrid Design[237]

Omni Hybrid Design[238]

An Omni hybrid is simply an extension of the series hybrid concept with a more focused design on modular functionality and growth for new technologies. In the Omni hybrid, a computer processor controls the power distribution. For example, if it were more efficient to increase the rpm of the engine to charge the batteries after they have been nearly depleted, the computer would do so. Further, if the operator demands an increase in acceleration, it does not necessarily mean more fuel will be burned at that instant (like in the case of an internal combustion engine). Further, when the vehicle is at

237 Copyright graphic from How Stuff Works with additional descriptors and elements added by the author. Available from http://auto.howstuffworks.com/hybrid-car2.htm; Internet; accessed on February 15, 2006.

238 The term "omni" hybrid was developed by the author and is a novel descriptor for the industry used to define hybrid functionality that is networked, interfaced, and modular in nature. The individual components that make an omni hybrid possible have been

cruise, it will only need to provide a trickle current to the electric motor, much like a wheel chair racer who only pushes the wheels every 10 revolutions or so. Whereas today's designs require a constant energy input (although less) at cruise speeds. The power processor will make all of the decisions as to whether a component is a power source element, direct-propulsion element, conversion element, or storage element of the available electrical energy.

In addition to the power distribution computer, a capacitor(s) and a power cord (for offline charging of the capacity and/or battery) should be incorporated into the design. The capacitor is introduced to handle surge acceleration requirements. These usually occur at startup (e.g. pulling into traffic) and over time could be re-charged for their next event. Also, multiple electrical motors (at each wheel) could be used. The omni hybrid would allow for safety features like advanced traction, all wheel drive, and a more distributed means of providing propulsion for the vehicle. Further, as with some hybrids in production, the braking of the vehicle is accomplished by converting the electric motor into a generator rather than today through frictional (heat) loss.

The most significant advantage to adopting the omni hybrid design is it provides plug and play architecture to utilize alternative fuels and/or engines as they become feasible. Because the omni hybrid design is not directly connected to its fuel source, it now becomes inconsequential as to what source of fuel is utilized. For example, the original omni hybrid can be made with a gasoline-fueled internal combustion engine. Later, that fuel could be converted to E85 ethanol fuel. Later, the internal combustion engine could be replaced a hydrogen fuel cell and even later the power source could be

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implemented by many car manufacturers independently, however most do not incorporate such a holistic design concept. A summary

obtained wirelessly. Unlike previous automobile designs (both hybrid and conventional) the omni hybrid design allows for growth of alternative fuel sources as they become practical and profitable without an entire re-design of the transportation industry.

Ultimately industry should adopt the omni hybrid infrastructure because:

1. It does not negate existing use of petroleum. With the omni hybrid, we can still take advantage of our well-established petroleum infrastructure.
2. It is a more efficient use of the available energy source(s). Regardless of the source of energy (coal, wood, petroleum) by converting to electrical propulsion, we most efficiently utilized the fuel.
3. It allows for emerging technologies to replace existing energy sources and engines as they become feasible and profitable through a modular design more capable of adapting with technology.
4. It has universal transportation application and transferability. Although this is an automobile example, the same could be accomplished for ships, trains, and aircraft in the near future. This same concept is used today in cruise ship propulsion and locomotive engines. In these vehicles a diesel engine provides power to an electric generator to propel the craft or vehicle. Further, it is believed that in supersonic aircraft an energy bubble or air spike carves a path through the air by ripping electrons from air molecules to form plasma. This forms a cushion between an airborne vehicle and the air around it at hypersonic speeds (the shockwave and the aircraft skin). As well as reducing drag, this layer of electrically charged air helps propel the aircraft. Powerful magnets accelerate the

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of example industry concepts is available from http://www.hybridcars.com/cars.html; Internet; accessed on February 15, 2006.

charged air past the craft, generating almost half the total thrust. This futuristic propulsion is called magneto hydro dynamics (MHD).[239] If the aircraft infrastructure were to be converted to electrical energy sources, alternative propulsion methods could be incorporated into future and existing aircraft.

239 The Science Channel. Megascience: Black aircraft; the mysterious US spy plane, Aired Monday, March 6, 2006 at 4:30 pm; Television and available from http://www.wtec.org/loyola/subsea/c3_s4.htm and http://web.mit.edu/mhl/www/index.htm; Internet; accessed March 13, 2006.

Bibliography

2003 Annual Report to the President, Information Security Oversight Office, available from www.archives.gov/isoo/reports/2003_annual_report.html; Internet; accessed January 17, 2006.

2006 State of the Union Address available at http://www.whitehouse.gov/stateoftheunion/2006/; Internet; accessed February 1, 2006.

Abedin, Jainul; Cloud Power: A letter with an evaluation by natural Science available from http://naturalscience.com/ns/letters/ns_let19.html; Internet; accessed on September 15, 2005.

Advanced Energy Initiative 2005 available from http://www.whitehouse.gov/news/releases/2006/01/20060131-6.html; Internet; accessed January 26, 2006.

Al Qaeda plan available from http://www.strategypage.com/dls/articles/20059240226.asp; Internet; accessed December 19, 2005.

Al Qaeda's energy strategy available from http://www.iags.org/n0124052.htm; Internet; accessed on November 11, 2005.

American Petroleum Institute available from http://api-ec.api.org/newsplashpage/index.cfm; Internet; accessed January 11, 2006.

Amidon, John, M.; America's Strategic Imperative: A "Manhattan Project" for Energy; Joint Force Quarterly; Issue 39; page 71; 4th Quarter 2005.

An Introduction to Thermoelectrics available from http://www.tellurex.com/cthermo.html; Internet; accessed on February 2, 2006.

Apollo Alliance Strategy available from http://www.apolloalliance.org/strategy_center/ten_point_plan.cfm; Internet; accessed on February 15, 2006.

Assignment Discovery; The properties and uses of aluminum, indium, tin, lead and other metals; Discovery Channel; 1 hour; Television; Aired Thursday December 15, 2005 at 5:00 am.

Average prices derived from world oil markets price chronology available at http://www.eia.doe.gov/cabs/chron.html; Internet; accessed February 20, 2006.

Biodiesel information available from http://www.unh.edu/p2/biodiesel/article_alge.html and http://homedistiller.org/wiki/index.php/Alcohol_fuel; Internet; accessed February 4, 2006.

Bloomberg Television; 1 Hour; Television; Aired February 7, 2006, at 6:00am

CAFE information available from http://www.ita.doc.gov/td/auto/cafe.html; Internet; accessed January 4, 2006.

Carter Doctrine available from http://www.jimmycarterlibrary.org/documents/speeches/su80jec.phtml; Internet; accessed December 2, 2005.

CBS Up to the Minute; 2 hours; WKTR- Norfolk; Television; Aired Monday, March 13, 2006 at 4:22 am.

Cell phones information available from http://news.com.com/Worldwide+cell+phone+sales+climb/2100-1039_3-5070434.html; Internet; accessed January 4, 2006.

Charts available from http://api-ec.api.org/filelibrary/KatrinaSlides.pdf ; Internet; accessed on December 7, 2005.

Chavez threatens to cut off oil to U.S.; available from http://www.cnn.com/2006/WORLD/americas/02/18/chavez.oil.ap/index.html; Internet; accessed February 16, 2006. Saturday, February 18, 2006; Posted: 4:59 a.m. EST (09:59 GMT).

Clean coal information available from http://www.fossil.energy.gov/programs/powersystems/cleancoal/; Internet; accessed on February 15, 2006.

Conduct of the Persian Gulf War, U.S. Department of Defense, April 1992.

Consumer Energy Council of America, Keeping the Power Flowing, January 2005.

Democrat energy plan available from http://democrats.senate.gov/energy/about.html; Internet; accessed on February 15, 2006.

Discovery Times Channel; The color of oil: power profits, and the environmental movement; 1 hour; Television; Aired Wednesday, January 4, 2006 at 10:00 am.

Distributed Energy information available from http://www.eere.energy.gov/de/; Internet; accessed September 18, 2005.

DoD energy efforts available from http://www.af.mil/news/story.asp?id=123016926; Internet; accessed March 13, 2006.

E85 Fuel information available from http://www.e85fuel.com/e85101/flexfuelvehicles.php; Internet; accessed on February 7, 2006.

EIA Annual Energy Outlook 2004, Figure 44

Election promises available from http://www.factcheck.org/article288.html; Internet; accessed on February 15, 2006.

Electricity prices available from http://www.eia.doe.gov/neic/infosheets/electricityprices.htm; Internet; Accessed February 26, 2006.

Energy harvesting information available from http://www.darpa.mil/; Internet; accessed on February 15, 2006.

Energy information available from http://www.asi.org/adb/02/09/he3-intro.html; Internet; accessed February 1, 2006.

Energy Security; Prepared by the Institute for the Analysis of Global Security; Al Qaeda's economic war against the United States; Available from http://www.iags.org/n0124052.htm; Internet; accessed on January 24, 2005.

Environmental Protection Agency available from http://www.epa.gov/ebtpages/humanhealth.html; Internet; accessed on February 20, 2006.

Estimates on petroleum available from http://www.eia.doe.gov/pub/oil_gas/petroleum/analysis_publications/oil_market_basics/Demand_text.htm; Internet; accessed February 20, 2006.

Events Affecting the U.S. Non-fuel Minerals Industry 1900-2000 summary available from http://minerals.usgs.gov/minerals/pubs/commodity/timeline/timeline.pdf; Internet; accessed on February 20, 2006.

Explanation of how today's cell phones work is available from http://electronics.howstuffworks.com/cell-phone4.htm; Internet; accessed January 5, 2006.

Fuel tax information available from http://www.cbsnews.com/stories/2005/02/14/eveningnews/main674120.shtml and

Germano, Frank; Tesla's Magnifying Transmitter: The history surrounding this amazing device!; available from http://mysite.verizon.net/vzeoyr81/magtrans.html; Internet; accessed on October 15, 2005.

Giannini, Robert M. and Le Pera, Maurice E.; Military Needs Efficient Fuel-Buying Process; National Defense Magazine; September 2004.

Greene, D. and Tishchishyna, N. Costs of Oil Dependence: A 2000 Update. May 2000, Oak Ridge National Laboratory

Harris, Martha; Energy and Security; Grave New World. Security Challenges in the 21st Century; Michael E. Brown: Editor; Georgetown University Press; page 157; 2003.

Health information available from http://www.epa.gov/ebtpages/humanhealth.html; Internet; accessed February 1, 2006.

Helium 3 information available from http://www.asi.org/adb/02/09/he3-intro.html and http://www.space.com/scienceastronomy/helium3_000630.html; Internet; accessed February 1, 2006.

House of Saud info Available at http://www.pbs.org/wgbh/pages/frontline/shows/saud/cron/; Internet; accessed on January 3, 2006.

How Stuff Works available from http://auto.howstuffworks.com/hybrid-car2.htm and http://www.nrel.gov/vehiclesandfuels/hev/hevs.html; Internet; accessed on February 15, 2006.

Huebner, Albert; Deadly Dependence: Why US petroleum Policy is Really about Global Domination; Toward Freedom magazine; Fall 2004

Hybrid gas tax available from http://www.sfgate.com/cgi-bin/article.cgi?file=/c/a/2005/04/20/MNGA4CBJH81.DTL and http://www.boston.com/news/nation/articles/2005/11/26/report_suggests_taxing_hybrid_cars/ and http://www.artba.org/economics_research/reports/gas_tax_history.htm; Internet; accessed February 8, 2006.

Hybrid market information available from http://www.abcnews.go.com/Business/Technology/story?id=1566135; Internet; accessed February 12, 2006.

Iraq coalition available from http://www.cryan.com/war/; Internet; accessed December 17, 2005.

Kendell, J., Global Oil Supply Disruptions Since 1951, EIA and Measures of Oil Dependence, EIA, 1998; Sept. 16, 1997. available from http://www.eia.doe.gov/security/distable.html and

Klare, Michael T.; Blood and Oil: The dangers and consequences of America's growing petroleum dependency; Metropolitan Books; 2004.

KPMG Survey available from http://www.ctv.ca/servlet/ArticleNews/story/CTVNews/20060104/hybrid_survey_060104/20060104?hub=TopStories; Internet; accessed January 26, 2006.

Kulcinksi, Cameron, Santarius, Sviatoslavsky, and Wittenberg, "Fusion Energy from the Moon for the 21st Century." 1988. Fusion Technology Institute, University of Wisconsin.

Lovins, Amory B. and L. Hunter; Energy Forever; The American Prospect; Pages 30-34; Rocky Mountain Institute; 11 February 2002.

Lovins, Amory B.; How America Can Free Itself of Oil-Profitably; FORTUNE Magazine. Copyright 2004 Time Inc; October 4, 2004.

Lovins, Armory B.; Ending our oil dependence; The Ripon forum; Volume, 39; Number II; page 13; March/April 2005.

Lynn, Larry; Statement; Director, Defense Advanced Research Projects Agency; Before The Committee on Armed Services Subcommittee on Acquisition and Technology United States Senate; March 12, 1998.

Manning, Robert; The Asian Energy Factor; New York; Council on Foreign Relations; 2000.

MegaScience; The Science Channel; 1 hour; Television; Aired Friday, January 13, 2006 at 4:00 pm.

Megascience: Black aircraft; the mysterious US spy plane; The Science Channel; Aired Monday, March 6, 2006 at 4:30 pm; Television

Moore, J. Oil Imports: An Overview and Update of Economic and Security Effects, December 12, 1997,CRS Report for Congress 98-1

National Energy Plan 2001 available from http://www.whitehouse.gov/energy/; Internet; accessed January 25, 2006.

KPMG Survey available from http://www.ctv.ca/servlet/ArticleNews/story/CTVNews/20060104/hybrid_survey_060104/20060104?hub=TopStories; Internet; accessed January 26, 2006.

Noble, Larry and Weiss, Steve; A Money in Politics Backgrounder on the Energy Industry; May 16, 2001 available from http://www.opensecrets.org/pressreleases/energybriefing.htm; Internet; accessed on December 2, 2005.

Nuclear development chronology available from http://www.dannen.com/decision/; Internet; accessed January 19, 2006.

Office of Naval Research: Energy harvesting available from http://www.onr.navy.mil/sci_tech/personnel/341/bbb_energy.asp; Internet; accessed on September 10, 2005.

Oil attacks available from http://money.cnn.com/2006/02/24/markets/oil_attack/index.htm; February 24, 2006: 3:15 PM EST; Internet; accessed March 13, 2006.

Oil demand available from http://www.eia.doe.gov/; Internet; accessed October 3, 2005.

Oil disruption available from http://www.msnbc.msn.com/id/10972979/\; Internet; accessed January 26, 2006.

Oil independence available from http://www.americanenergyindependence.com/; Internet; accessed on February 15, 2006.

Oil statistics available from http://www.gravmag.com/oil.html; Internet; accessed December 1, 2005.

Patch, Kimberly; Chips turn more heat to power; Technology Research News; Available from http://www.trnmag.com/Stories/2001/121901/Chips_turn_more_heat_to_power_121901.html; Internet; accessed on October 12, 2005.

Peak production available from http://www.opinionjournal.com/weekend/hottopic/?id=110007377; Internet; accessed October 11, 2005.

Petroleum education: The History of oil available from http://www.priweb.org/ed/pgws/history/spindletop/spindletop.html; Internet; accessed on December 10, 2005.

Presidential energy promises available from http://www.reason.com/rb/rb072104.shtml; Internet; accessed on February 15, 2006.

Renewable energy available from http://msnbc.msn.com/id/5963503/site/newsweek/; Internet; accessed March 13, 2006.

Republican energy plans available from http://www.whitehouse.gov/energy/; Internet; accessed February 20, 2006.

Robert L. Vitale. Report number: A272763. JUN 1999 available from http://www.stormingmedia.us/27/2727/A272763.html; Internet; accessed January 19, 2006.

Roberts, Paul; The End of Oil: On the Edge of a perilous new world; Houghton Mifflin Company; Boston and New York; page 118; 2004.

Solar power information available from http://www.solarpowergetics.com/servlet/the-151/Solar-Transparent-Nanofilm/Detail; Internet; accessed March 13, 2006.

Soubel, Andrew K.; Solar Power Satellites and Microwave Power Transmission. Energy Law Spring 2004 Chicago-Kent College of Law. US Department of Energy; EREC Brief Solar Power Satellites; available from http://www.eere.energy.gov/consumerinfo/refbriefs/l123.html; Internet; accessed on December 2, 2005 and available from http://sbir.nasa.gov/SBIR/abstracts/04/sbir/phase1/SBIR-04-1-X2.03-9461.html; Internet; accessed January 12, 2006.

Space Power; SPS Timeline; available from http://www.spacefuture.com/power/timeline.shtml; Internet; accessed September 10, 2005.

Standing, Tom; Making Hydrogen?; Oil & Gas Journal; April 14, 2003.

State Government Tax Collections Summary Tables, available from http://www.census.gov/govs/www/statetax.html; Internet; March 2005 data accessed January 7, 2006.

Street Signs; CNBC; 1 hour; Television; Aired Wednesday February 1, 2006 at 2:15 pm

Summary of example industry concepts is available from http://www.hybridcars.com/cars.html; Internet; accessed on February 15, 2006.

Sun lifetime available from http://www.madsci.org/posts/archives/mar97/853714295.Ph.r.html; Internet; accessed November 22, 2005.

SUV markets available from http://money.cnn.com/2004/05/17/pf/autos/suvs_gas/; AND http://www.greencarcongress.com/2005/05/sales_of_fullsi.html AND http://www.post-gazette.com/pg/05076/472585.stm AND http://www.washingtonpost.com/wp-dyn/content/article/2005/12/01/AR2005120100737.html Internet; accessed January 11, 2006.

Syriana; Movie Reel; A&E Network; 1 hour; Television; Aired Saturday, December 10, 2005 at 5:00 pm.

Tesla frequently asked questions available from http://www.tfcbooks.com/teslafaq/q&a_051.htm; Internet; accessed on December 15, 2005.

The Electric Earth; available from http://www.thunderbolts.info/tpod/2005/arch05/051012electric-earth.htm; Internet; accessed on December 13, 2005.

The National Security Strategy of the United States. March 2006. Available from http://www.whitehouse.gov/nsc/nss.html; Internet; accessed April 10, 2006.

Toyota sales available from http://abcnews.go.com/Business/wireStory?id=1588361; Internet; accessed February 11, 2005.

Turby windmill information available from http://www.opensourceenergy.org/C17/News%20Viewer/default.aspx?ID=1075; Internet; accessed March 13, 2006.

U.S. Census Bureau, Foreign Trade Statistics, Exhibit 1 and 17, March 2004.

Understanding Electricity; The Science Channel; 1 hour; Television; Aired Jan 11, 2006 at 8:00 am.

Understanding: Car Travel becomes Increasingly Hazardous; The Science Channel; 1 hour; Aired, Friday February 3, 2006 at 5:00pm.

US government energy plans available from http://www.energy.gov/; Internet; accessed January 2, 2006.

Venter, J. Craig; Cracking the Ocean Code; The Science Channel; 1 hour; Television; Aired Friday, December 9, 2005 at 3:00pm

Wahl, J., Oil Slickers: How Petroleum Benefits at the Taxpayer's Expense., 1996, Institute for Local Self Reliance

Weakening SUV sales available from http://money.cnn.com/2004/05/17/pf/autos/suvs_gas/; AND http://www.greencarcongress.com/2005/05/sales_of_fullsi.html AND http://www.post-gazette.com/pg/05076/472585.stm AND http://www.washingtonpost.com/wp-dyn/content/article/2005/12/01/AR2005120100737.html Internet; accessed January 11, 2006.

Willrich, Mason; Energy and World Politics; The Free Press; page 104;1975.

World energy use available from http://www.zpenergy.com/modules.php?name=News&file=article&sid=797; Internet; accessed on March 13, 2006.

World oil markets price chronology available at http://www.eia.doe.gov/cabs/chron.html; Internet; accessed February 20, 2006.

World oil prices available at http://www.eia.doe.gov/cabs/chron.html; Internet; accessed February 20, 2006.

World population statistics available from: http://www.census.gov/ipc/www/world.html; Internet; accessed February 2, 2005.

World production of crude petroleum available from http://digicoll.library.wisc.edu/cgi-bin/EcoNatRes/EcoNatRes-idx?type=article&byte=30811112&isize=text; Internet; accessed February 20, 2006.

Yerbin, Daniel; The Prize: The Epic Quest for Oil, Money, and Power; New York; Touchstone; 1992.

Yergin, Daniel and Stainislaw, Joseph; The Commanding Heights: The Battle between government and the marketplace that is remaking the modern world; New York; Simon and Schuster; 1998.

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